THE TELEGRAPHIC JOURNAL AND

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AMERICAN TELEPHONE PATENTS.

THE intelligence which comes from the United States detailing the latest phases of telephonic litigation there, is somewhat perplexing. We were able to inform our readers a fortnight ago that "the United States" had resolved to proceed against the American Bell Telephone Company in the pending action brought at the instance of the National Improved Telephone Company. This, upon the face of it, seemed to suggest that the powerful corporation was in danger, for one naturally imagined that the Government would not concern itself with a case which did not present strong evidence of injustice, to say the least. Then last week came the somewhat sensational announcement that an Examiner in the Patent Office, Z. F. Wilber, had admitted that Bell or his agents were allowed, in contravention of the law upon the subject, to see the caveat filed by Elisha Gray on the same day as Bell's application was made; and this seemed to make the reason for the interference of the Government clear.

Later papers from America contain fresh information. The *New York Times* says that the other allegations in the Bill of Complaint against the Bell Company, except those relating to Reis's discoveries and Bell's acquaintance with the same, are closely connected with the disclosure of the contents of Gray's caveat, but that, as they are set out in the Bill, they have a value of their own. It is shown that Bell's application was for a patent covering "certain new and useful improvements in telegraphy," and the Bill proceeds to state that the drawings, specifications and claims filed therewith were "so cunningly and artfully written and contrived as to make the same appear to relate to improvements in harmonic multiple telegraphy and to no other matter or invention whatsoever," and that the devices and apparatus claimed by Bell to be adequate for the accomplishment of the specified work were inadequate and worthless. On the other hand, Gray's caveat set forth clearly an alleged invention styled, "A new art of transmitting vocal sounds telegraphically."

This is certainly an assertion of an extraordinary character, and one to which it is somewhat difficult to give credence. It impeaches the efficiency of the officials of the Patent Office to an extent that is not usual even in such a land of disappointed inventors as America. But the assailing party in this case are nothing if not bold; they *do* impute incompetency and ignorance to the responsible people in the Patent Office; and not only this, they are not sparing in something stronger than hints of collusion on the part of officials higher than the penitent Wilber. In further proof of the boldness of the attack we give these extracts from the bill of complaint: It is said that Bell, having heard from Wilber the contents of Gray's caveat, and having secured the removal of the suspension order, "cast about to obtain undue and unjust advantage and to embarass and defeat Gray in any future effort to obtain letters patent for the supposed invention described in the caveat." The complainant further alleges that Bell procured his patent by means of "false suggestion, concealment and deceit," and that "as soon as he had obtained his patents he at once threw off all disguise and openly pretended and claimed" that the patent related not only to certain impracticable devices to be used in harmonic multiple telegraphy, but confirmed to him "a full and complete monopoly of the transmission of spoken words through the agency of electricity."

These strong statements, and presumably the evidence which the suing parties have in support, were quite sufficient, if what we are told is correct, to justify the Government in prosecuting the suit; but the utility of the course is said to be confined to that which may be gained from the additional weight placed in the scales against the Bell Company by the name of "the United States."

Another New York paper, the *Evening Post*, suggests other reasons than those pointed out above for the granting of the assistance of the Government. It states that the special Government counsel appointed to assist in this case are all connected with rival telephone companies, three out of the four with the Pan Electric Company, and the other with the National Improved Company. Then several prominent politicians are shown to be large shareholders in the Pan Electric Company, amongst these being Augustus H. Garland, Attorney-General, holding 10,000 shares. The *Evening Post* further says:—"Those who are familiar with the practice of the Patent Office say that it has been the habit for the Attorney-General to refer to the Commissioner of Patents applications for leave to bring suit in the name of the United States to set aside a patent. Careful enquiry fails to discover that this application was referred to the Commissioner. The fact that these distinguished Government officials are directors in an opposition company, and that the suit against the Bell Telephone Company could only have been brought by the direction of one of them, is a circumstance of which, in the nature of things, the Bell Company will be likely to take such advantage as it can." There can be only one meaning in these remarks, and the suggestion is one which is happily rare on this side of the Atlantic; but if the facts are as stated, some little explanation will be required to give the prosecution a wholesome appearance.

But, after all, it is not—or should not be—so much a question of whether the Government prosecutes or not. The testimony which the complainant can adduce, will be that to which all men's minds will be turned, and what has been already said leads to the supposition that there is confidence in the attacking camp, and that they have methods and weapons of onslaught which the Bell Company will not find so easy to combat as those

which have already fallen before it. The affidavit of Wilber, a copy of which we give on another page, imports an element with which the Bell Company has not hitherto had to deal, and some curiosity is manifested as to how it will be met.

One result of the coming litigation is pretty certain to be a thorough threshing out of the Bell claims, and if these come uninjured through the ordeal it will be matter for great self-gratulation on the part of the Bell monopolists.

THE BRITISH ASSOCIATION.

(Specially Reported for the "Electrical Review.")

ON A MODIFICATION OF THE DANIELL BATTERY, USING IRON AS ELECTRO-POSITIVE ELEMENT.

By J. J. COLEMAN, F.I.C., F.C.S.

(Section A.—Mathematical and Physical Science, September 16th.)

IT seems very singular to me that more attention has not been bestowed upon the utilisation of iron as the substance to be burned in the battery, seeing that the oxidation of iron, according to the researches of Andrews and Faire and Silberman developes two-thirds or three-fourths as much heat, weight for weight, as zinc. The exact figures are these, 677 as against 847, supposing the iron is used to precipitate copper sulphate solution instead of zinc. Iron has been frequently used as the electro-negative element of a battery, especially when in the passive state, by contact with concentrated nitric acid. Probably the objection to its use as an electro-positive element has arisen from the earlier experiments finding local action uncontrollable, which in the case of zinc could be obviated by the expedient of amalgamation. I have recently made some experiments in this direction. In point of fact, I have constructed a sulphate of copper cell in which the copper is used in contact with sulphate of copper as is customary in Daniell's cell, but the zinc is replaced with iron used in contact with ferrous sulphate. I find that three of such cells connected in series decompose water, so that the E.M.F. is probably what theory indicates, about two-thirds of a Daniell cell. Moreover, such a form of battery gives what the practical chemist dearly loves, viz., a chemical cycle easily worked, and restoring the materials to their original state. The solution of sulphate of iron produced by the working of the battery on evaporation and distillation yields sulphuric acid and peroxide of iron, the former ready to be combined again with the deposited copper, and the latter ready for the blast furnace to be reconverted into metallic iron. For prevention of local actions, I find that a form of battery similar to the Medinger or Sir William Thomson battery answers, with some important practical alterations of detail, and this battery requiring no porous cells, can be made of any size desirable.

A saturated solution of sulphate of copper contains one-fifth of its weight of the salt, and it floats upon a saturated solution of sulphate iron, which contains only about one-third of its weight of the salt, so that if the sulphate of iron is drawn off in the saturated state, the copper plate requires to be at the top and the iron at the bottom of the battery cell. If, however, the saturated solution of copper sulphate be divided into two portions, and the copper of one portion be replaced by iron, then it will be found that the iron solution floats upon the sulphate of copper solution, the line of demarcation between the two being distinct, and remaining so for weeks without any separating diaphragm. Consequently, a manageable and constant cell is easily constructed by a copper plate being put at the bottom of the cells in the solution of sulphate of iron (protected from the atmosphere by a layer of mineral oil), a saturated solution of copper sulphate being continuously supplied by a tube to the bottom of the tank, and the solution of sulphate of iron being continuously drawn from the top of the tank. I have had three such cells connected together working side by side, with two exactly similar cells constructed with copper and zinc in solution of sulphate of zinc. They have remained constant eight days, and the iron arrangement yields in a decomposing cell of copper sulphate outside the battery two-thirds of the copper yielded by the zinc arrangement for equal quantities of electricity. The iron battery will, therefore, require plates of twice the size of the zinc battery, but, on the other hand, it is only one-fourth the price of zinc. There should be no cost in working this battery beyond that incidental to the removal of the products, their boiling down and distillation or reduction by coal, and their return to the place from whence they came, and the cost of the current should approximate closely to what Mr. Probert says is the cost of lighting by the dynamo. It is obvious, also, that torrents of electricity could be evolved from the iron used in precipitating copper by Henderson's wet process if the tanks be arranged in a similar way. I may mention that I have obtained powerful currents by dipping plates of iron and copper into a solution of common salt mixed with chloride of lime.

ON THE DEVELOPMENT OF THE PNEUMATIC SYSTEM AS APPLIED TO TELEGRAPH PURPOSES.

By J. W. WILLMOT.

(Section G.—Mechanical Section, September 14th.)

IT is probably not generally known by what means telegraphic messages are collected from the branch offices in large towns and conveyed to the central office for transmission by wire.

This service is performed by means of pneumatic tubes through which "carriers" containing the actual written messages are propelled—in one direction by compressed air, and in the opposite direction by rarefaction of the air in the tube.

The system was first introduced by Mr. L. Clark in 1854 who employed vacuum, drawing the carriers in one direction only. The first tube which came into operation was laid for the Electric Telegraph Company between their office in Lothbury and their branch office at the Stock Exchange. This tube was in continuous use for over 20 years, and from a piece which I have here it will be seen that, beyond the inner surface being polished, the pipe is very little the worse for the service it has seen.

About the year 1866 Mr. C. F. Varley applied compressed air for propelling the carriers in the opposite direction from that in which they were drawn by vacuum, and very ingenious valves were at that time designed by him for effecting the necessary changes in the direction of the flow of air through the tube.

With each of the foregoing systems it was necessary, after the transmission of a carrier, to restore the pressure in the tube to the normal atmospheric pressure before another carrier could be despatched. This caused considerable delay and loss of engine-power.

In 1870 the author designed the double-sluice valve, which is now in general use, and by means of which carriers can be despatched continuously without stopping the flow of air in the tube. The principle of this valve is that the upper sluice shall be closed before the lower one is opened and *vice versâ*.

The employment of pneumatic tubes in London has been continually increasing until the system which in 1854 was represented by one 6 H.P. engine working a single tube a few yards in length at the present time comprises four 50 H.P. engines (each indicating 130 H.P.) and 49 tubes, the aggregate length of which exceeds 27 miles. These figures are exclusive of over a mile in short lengths of house tubes, also worked by the engines, as well as of over a dozen hand-worked tubes in various metropolitan offices.

The use of pneumatic tubes, however, has not been restricted to London alone. Each town, as it has become telegraphically important, has been provided with a pneumatic system.. There are in London and the provinces 112 tubes, having a total length of over 39 miles and requiring 14 engines having a total of 364 (nominal) horse-power to work them.

To these should be added, in order to fairly represent the pneumatic system, 95 shorter hand-worked tubes fitted at various less important places.

With the air pressure employed—10 pounds pressure and eight pounds vacuum—an approximate speed of one mile in 70 seconds is attained in tubes not exceeding a mile in length. The speed varies inversely as the square of the length of the tube.

The pipes generally employed are of lead, having an internal diameter of 2¼ inches. These pipes are carefully drawn, and are joined together by means of a plumber's joint made upon a heated steel mandril, which is drawn out by means of a chain after the joint has been made. The lead tubes are protected by being laid in ordinary cast iron socket and spicket pipes.

In view of the anticipated increase in the number of messages which will result from the introduction of the sixpenny telegram tariff, considerable extension of the existing pneumatic system has been made at several places, more especially at Liverpool. At that place six new tubes have been laid and three 30 H.P. beam engines (each indicating up to 90 H.P.) have been erected. Of these engines two are kept working and one as spare. They were designed and constructed under the personal supervision of the author, and were made by Messrs. Easton & Anderson, of Whitehall Place, London, and Erith, Kent. The following is a detailed description of their general arrangement.

The machinery consists of three engines, each working two pneumatic pumps, any two engines being capable of doing the full amount of work required. The third engine is kept in reserve. Steam is supplied from two multitubular Cornish boilers—one boiler being sufficient to work at one time.

The engines are high pressure condensing beam engines, and are completely self-contained on one continuous cast iron bed-plate. The beam, which is cast iron, is supported by two A frames of box section bolted on to the bed-plate. These also carry the entablature round the beam. The bed-plate itself is bolted down to brick piers.

Placed under each extreme end of the beam and connection to the air and vacuum mains is a double-acting air pump of 2 feet diameter and 3 feet 11 inches stroke. At top and bottom of each pump on one side is a nest of valves, which valves open outwards, and on the other side are valves similarly arranged, which open inwards. On the passages between the valves and the pneumatic mains is a three-way sluice communicating either with pressure or vacuum mains or with the atmosphere. Thus, it will be seen, that if the sluice on that side of a pump on which are the valves which open inwards be open to the atmosphere while the sluice on the opposite side is open to the pressure main,

the pump will take by suction from the air, and deliver air after compression into the pressure main. Similarly, if the sluice on the inlet side of the pump be open to the vacuum main while the sluice on the opposite side is open to the air, the pump will exhaust from the vacuum main and deliver to the air. Consequently, the pumps are interchangeable and may be worked at will for either pressure or vacuum. This arrangement is very simple, there being only two sluice valves on each pump instead of four, as in some other instances. Each pump is provided with a 2 inch relief valve, so that the change from pressure to vacuum may be made while the engine is running without unduly raising the pressure in the pumps. The pressure and vacuum pump valves are of leather, each valve having an area of 10 square inches.

The steam cylinder is 18 inches in diameter with 2 feet 7 inches stroke, steam jacketted, and lagged with felt and teak in the usual way. It is placed between the rear pump and the main A frames.

The main slide valve is worked from an ordinary eccentric on the crank shaft, but the expansion slide has an independent motion from the beam. A wrought iron lever is pivotted on a casting on the entablature frame, one end of the lever is connected by a link to the beam, while the other is connected to the expansion valve spindle which passes through a "bow-bracket" on the top of the slide chest cover; a bevel pinion on the slide rod gears into another small pinion in connection with a hand-wheel carried by means of the above-mentioned bow-bracket, by which the expansion may readily be varied while the engine is running. The steam-starting valve and injection cock are in close proximity, so that the engine man has all the means of regulating his engine close at hand.

The air pump and condenser are fixed underneath the bed-plate. The former is bolted to the bed-plate and is worked direct from the beam by the same system of parallel motion as the engine piston and pump rods.

The condenser is of the ordinary "jet" description. In event, however, of shortness of water for condensation, provision has been made for working the engines non-condensing, exhausting the steam into the chimney shaft. As, however, arrangements are being made to cool and circulate the condensing water, it is only in very exceptional circumstances that it will be necessary to work non-condensing.

The connecting rod is of cast iron, with the same stroke of crank as that of the piston.

The entablatures which surround each beam are connected together, and are reached by a wrought-iron stair from the engine room floor.

The two steam boilers are of the multitubular Cornish type, 6 feet 6 inches diameter and 20 feet 1½ inches long, with double flues, the flues terminating in 74 tubes 3 inches diameter and 6 feet long. The boilers are set on cast-iron chairs with a return flue first underneath the boilers, dividing in front and returning along either side to the back where the draught enters the main flue to the chimney shaft.

The boilers are of mild steel throughout and have been tested with hydraulic pressure up to 150 lbs. on the square inch to work at 70 lbs. steam pressure.

It was found in working that one boiler was quite capable of providing steam for the two engines with the damper partially closed; on opening the damper, the steam very soon began to blow off at the safety valves.

The boilers are fitted with double dead weight safety valves and all other fittings required by steam users.

For the supply of feed water each boiler is fitted with an injector and, in addition, there is a donkey pump connected to both boilers.

The engines here described are situated in an engine house 320 yards distant from the Liverpool Head Post Office, with which they are connected by two air mains 12 inches in internal diameter. These air mains consist of cast-iron pipes with carefully-fitted male and female flange joints. The joints are packed with thick vulcanised rubber rings between the flanges to allow for contraction and expansion of the pipes, and are perfectly air-tight, with an air-pressure of 30 lbs. to the square inch.

AN ELECTRO-CENTRIFUGAL MACHINE FOR LABORATORY USE.

By ALEX. WATT, F.I.C., F.C.S.

(*Section B.—Chemical Science, September 16th*, 1885.)

THE instrument which I have the honour of bringing to the notice of this section, although in itself possessing no scientific interest, has been found so useful in the laboratory as to justify the hope that a description of it and a demonstration of its uses may prove of interest to the members. The late Dr. Mohr, of Bonn, in his "Titrimethode," advocated the use of a centrifugal machine for the rapid drying of crystalline precipitates for use in volumetric analysis, and although these are admirably adapted for such purposes, centrifugal machines are seldom seen in our chemical laboratories. It is possible that the neglect of this valuable addition to our laboratory apparatus is owing to the inconvenience involved in driving the machine at a high speed by means of the ordinary pulleys or other power-multiplying gear, especially when the rotation has to be kept up for a considerable length of time.

It therefore occurred to me that by directly attaching an electro-motor to the revolving drum or basket (or table, as in Mohr's instrument) the inconvenience attending the driving might be got over, and at the same time a combination of great efficiency would result, as the electro-motor, like the centrifugal machine, is most efficient when driven at a high speed.

The apparatus (before you) consists essentially of a basket or drum of perforated copper (it might be of iron or other suitable metal or of ebonite) slipped on to a cone attached to the spindle of a small electro-motor, and is held in position by means of a nut. The surrounding casing serves to catch the liquid driven out of the substance being dried. The electro-motor consists of a Siemens' H armature, which revolves between the poles of an electro-magnet of soft iron. The centrifugal machine, as is well known, has many industrial applications. It is used in laundries and in the textile manufactures for drying wool and cloth; in dye works for drying feathers, and in the manufacture and refining of sugar for the separation of the sugar crystals from the syrup; but it is only quite recently that chemical manufacturers have awakened to its value. I propose now to show you the separation of syrup from sugar, which, I think, will sufficiently illustrate its use for laboratory purposes.

ON SOME ACTIONS OF A GROVE'S GAS BATTERY.

By Prof. WILLIAM RAMSAY, Ph.D.

(*Section B.—Chemical Science, September 10th.*)

THE chief point of interest in this paper is that in a gas battery in which the re-acting gases are hydrogen and oxygen, and the liquid dilute sulphuric acid coloured with indigo, the indigo is not reduced in the tube containing hydrogen, but is oxidised in the tube containing oxygen. But if the gas couple be hydrogen and chlorine, and the liquid a saturated solution of common salt, the indigo in the hydrogen tube is reduced from the top downwards. A possible explanation of this phenomenon is, in the author's opinion, that while hydrogen in the act of combining with chlorine must become atomic, or nascent, if the equation

$$H_2 + Cl_2 = 2\,H\,Cl,$$

the equation

$$2\,H_2 + O_2 = 2\,H_2O$$

does not necessitate the splitting of the hydrogen molecules, but it is conceivable that combination occurs between molecular hydrogen and atomic oxygen; and as it has been found that the oxygen side of the battery is always active, it appears that atomic oxygen, or one of its products, hydrogen dioxide or ozone, is formed.

ELECTRO-OPTIC ACTION OF A CHARGED FRANKLIN'S PLATE.

By J. KERR, LL.D.

(*Section A.—Mathematical and Physical Science, September 15th.*)

IN his opening remarks on electro-optics,* M. Wiedemann draws attention to the experiments tried on Franklin's plates by MM. Quincke, Gordon, Mackenzie and Grassman; and he seems to accept the absence of effect in these experiments as decisive of the question of action or no action, in a uniformly charged plate of glass. Accordingly when he comes to the earliest known instance of electro-optic double refraction, he introduces the author's experiment as an example of a *non-uniform* and *optically active* electric field, in contrast with these other experiments, as examples of a field sensibly *uniform* and *optically inactive*. The author's objection to Wiedemann's theory has always been that it ignores those pure and intense effects which he obtained long ago in dielectrics, particularly in carbon disulphide, and in a sensibly uniform field.

The statement by Wiedemann, that there appears to be no electro-optic double refraction in the case of a uniformly charged Franklin's plate, is not true in any other sense than as a record of several inadequate experiments. The author found that a charged Franklin's plate, with uncoated margin so wide only as to give a small working difference of potentials, acts upon transmitted light in the same way as olive oil, amyl oxide, or any other negative dielectric.

The author describes in detail the experiments by which he arrives at the conclusion that *electrostatically strained glass acts in the polariscope as if compressed along the lines of electric force, and this always, whether the electric field is uniform or not.* He concludes:—We are led thus by the facts of electro-optics and independently of all theory to the conception and realisation of *electrostatic strain*, and have a remarkable confirmation of the theoretical views of Faraday and Maxwell.

REPORT ON THE STANDARD OF WHITE LIGHT.

(*Section A.—Mathematical and Physical Science, September 14th.*)

THE committee on a standard of white light reported that during the past year experimental work had not been extensive, as they had no funds at their disposal for experimental research, and they had been chiefly occupied with reviewing what had been done in

* *Die Lehre von der Electricität*, vol. ii., p. 125.

the past and trying plans for future operations. A consideration of existing standards convinced the committee that the standard candle as defined by Act of Parliament was not in any sense of the word a standard. They had looked into the merits of different proposed standards, and the majority felt satisfied that for all the present commercial requirements the Pentane standard of Mr. Vernon Harcourt, since it had no wick and consumed a material of definite chemical composition, when properly defined was an accurate and convenient standard, and gave, more accurately than the so-called standard candle, an illumination equal to that which was intended when the Act was framed. Yet the committee, while desiring to impress the Board of Trade and the public with these views, did not feel inclined at present to recommend the adoption of any standard for commercial purposes until further information on radiation had been obtained for experiment. They desired to be re-appointed, and asked for a grant of £30 to enable them to carry out certain researches which they indicated in this direction.

DELANY'S SYNCHRONOUS MULTIPLEX PRINTING TELEGRAPH.

THIS apparatus is a fresh adaptation of the system invented by Mr. Delany, and which was described in the number of the REVIEW for February 2nd, 1884.

FIG. 1

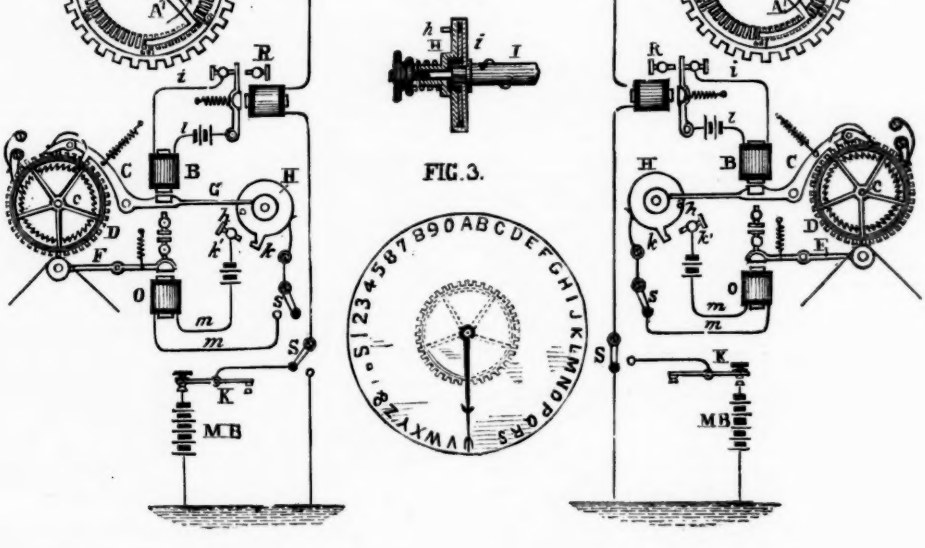

FIG. 2.

FIG. 3.

In fig. 1 two connected stations, X and Y, are shown, each having a branch line connected to a single contact. In this fig. the 9s and 10s on the table of contacts, A, at each station are to be utilised for maintaining the synchronous movement of the arms, A', A', in the manner described in the article referred to. When the trailing fingers, A', are moving synchronously, and come upon corresponding contacts at the station, there will be momentarily a complete and independent circuit from the branch line connected with one of the contacts at one station to the branch line connected with the contact at the other station.

If a printing, registering, or indicating telegraphic apparatus be connected with each of the working contacts at these stations with suitable batteries and transmitters, such instruments will be placed in brief communication with each other during each revolution. If the rotating circuit-completers, A', rotate three times a second each pair of branch lines will get three impulses a second. These impulses may be utilised to actuate the sending and receiving apparatus. If such apparatus is of the ordinary step-by-step character, so as to be manipulated by successive completions of the circuit to print, register, or indicate the letter or word transmitted, it is obvious that messages may be transmitted as accurately between each pair of corresponding instruments as if the line were devoted exclusively to their use. Thus, with a table of 80 contacts connected by a single main line, 72 private and independent circuits will be obtained between the two stations.

The transmitting and receiving apparatus at the two stations is preferably of the simplest character, so that skilled operators may be dispensed with. Such apparatus, either dial instruments or alphabet printers, are well known.

Referring specially to fig. 1, a corresponding contact at each station is shown as connected through the coil of a relay, R, to earth. A description of one pair of branch circuits will, of course, be sufficient.

From the relay, R, the line may be connected with the battery, M, B, through a key, K, or put to earth by a switch, S. The key, K, stands for a letter-board of a printing telegraph transmitter. The terminals of a local circuit, *l*, are connected respectively with the armature of the relay, R, and its back stop. An electromagnet, B, in this circuit actuates a pivoted push lever, C, acting on a toothed wheel on a shaft, *c*, which carries the type-wheel. With the switch, S, at station, X, put over so as to include the key and battery in the circuit, and the line put to ground at station, Y, the operation is as follows :—

The key, K, at station, X, is normally open. A pointer on the end of the shaft, *c*, of the printing apparatus, fig. 3, traverses a dial bearing the letters of the alphabet, or such other signs as are to be transmitted. The pointers at both stations rest normally upon the zero point. If the key, K, at station, X, is depressed, the impulses transmitted over the main line to the relay, R, at station, Y, open and close the normally closed local circuit, *l*, and vibrate the lever, C, thus causing the dial pointer and type-wheel to rotate. This occurs at both stations. When the finger on the dial therefore reaches the letter or sign which is to be printed, the operator at X lifts his fingers, opens the circuit, and the

pointer and type-wheel at both X and Y pause. The key is then depressed until the apparatus is rotated to the next signal or letter. If it is desired to print as well as indicate a signal on the dial, a strip of paper is fed between the type-wheel and the pivoted printing lever, F, in the usual way. An arm, G, extends from the rocking push lever, C, partly across the face of a disk, H. This disk is carried upon a spindle, I, of the clock-work. It is loosely mounted thereon, but is in frictional contact with a disk, *i*, fast on the shaft. The amount of friction may be regulated by a thumb-nut and spring on the end of the shaft. A pin, *h*, projects from the face of the disk into the parth of the arm, G. The friction disk, H, also carries a contact finger, *k*, which is arranged in such proximity to another contact finger, *k'*, that a comparatively small movement of the disk, H, is required in order to bring the contacts, *k*, *k'*, together and complete a local circuit, *m*. This local circuit includes the coils of a magnet, O, which operates to throw the printing lever up against the type-wheel and print the desired character. The pin, *h*, on the disk, H, is in such relation to the end of the arm, G, that when the key at the transmitting station is kept closed and the magnet, B, is energised with comparative rapidity—three times more or less a second—to rotate the type-wheel, the pin, *h*, is constantly snubbed back by the end of the arm, G, so that the disk, H, is never permitted to rotate a sufficient distance to bring the contacts, *k*, *k'*, together; but when the key at the transmitting station is opened to indicate or print a signal, one or more periodic impulses are prevented from entering the line, and the vibrating lever, C, and arm, G, carried thereby remain at rest a longer period; and as the local circuit, *l*, is completed the magnet, B, keeps the lever, C, drawn down so as to elevate or move the arm, G, away from the pin, *h*. This permits the tardy circuit-completer to complete the local, *m*, at the contacts, *k*, *k'*, when the strip of paper is thrown up against the type by the printing lever, F. When the transmitting key at the distant station is closed, the step-by-step rotation of the apparatus is again contined, the pin, *h*, being snubbed back by the arm, G, so as to open the local, *m*.

The system contemplates the establishment of exchanges in cities connected by one or more main line wires, so that the private line subscribers in both cities may communicate with each other.

An advantage in the system is the fact that it is impossible to "tap" a line.

ELECTRIC LIGHTING IN THE UNITED STATES.

(*Continued from page* 271.)

As in New York, so also in other eastern cities, Brush and Weston lamps are nearly always employed for public lighting, and for the supply of electric lights on the rental system. Generally, local companies are organised to supply these lights, the capital being subscribed in each city or district where the lighting station is erected. The dynamos, lamps, &c., are in this case purchased from the parent companies, who manufacture the apparatus, and are supplied on very favourable terms to the said local companies.

Latterly, the Thomson-Houston system has become quite a rival to the Brush and Weston. In the city of Boston, Mass., for instance, the bulk of the public lighting is in the hands of the Thomson-Houston Company, although there are also a good number of Brush lamps employed for the same purpose.

The electric light poles in Boston are not so high as those in New York, and being made of cast iron, have altogether a neater appearance than the more clumsy wooden poles in the latter city. One would wonder why the æsthetic Bostonians do not object to the overhead electric light wires. The beautiful public garden, for example, is disfigured to a considerable extent by the white cotton-covered wires which are stretched from pole to pole, and which supply the current to a number of Thomson-Houston lamps. Surely sooner or later these wires must be placed underground! In the Brunswick Hotel are to be found the remains of what was once an incandescent light installation. Why the lamps have been taken away is probably not difficult to conjecture; but there is an inclination to sigh when one sees disused and filthy electric light fittings in different parts of the building.

In some eastern cities the municipal authorities have decided not to adopt the electric light in the streets. Washington is one of these cities. Here there is no public electric lighting, with the exception of a few arc lights which illuminate the grounds of the Capitol. Probably the overhead wire is responsible for this. A number of Weston arc lights, however, are supplied to the stores; but some of the hotels, &c., have their own isolated plants. The Riggs House has a miserable installation of twelve lamps on the Thomson-Houston system. Indeed, it is positively painful to be in the dining room or reading room at night under the fitful glare of these lamps, while the hissing and spluttering noise they make is almost unbearable. However, it may be some consolation to the owners to find that they save $600—say, £120 per annum over gas lighting.

An exceedingly interesting installation on the Brush system is to be found at Rochester, N.Y., on account of the power being derived from the river Genesee. This was fully described and illustrated in the ELECTRICAL REVIEW some time ago. Turbine wheels are used, the water being supplied by a race at the lower Genesee Falls, which leads into the Brush Company's works. Sufficient power can be obtained to work 1,000 arc lights, but at present there are only about 300 Brush lights in operation. The Brush Company has the contract for all the public lighting in the city, the charge being 45 cents per lamp per night. Double carbon lamps are used in the city lighting, so as to burn all night. In some of the streets the lamps are placed in the centre of the road, but generally wooden poles about 30 feet high are employed. A number of Brush single carbon lamps are also supplied to the Powers and other hotels, and some of the stores.

The double carbon lamps in the streets do not burn as well in this city as in some other cities, and frequently two or three together may be seen out, or, at any rate, in a state of incandescence. The United States Company has also a lighting station in Rochester, and supplies 150 or 160 single carbon Weston arc lights to the different stores. Their dynamos are driven by steam power. This company charges its customers 40 cents. per lamp per night, and, on the whole, their lamps seem to be preferred to the Brush. So many Brush and Weston lamps are in use in Main Street that at night it is simply one blaze of light.

In the Powers Block (the principal building) is an installation of 50 Fuller arc lights, whilst a number of Swan incandescent lamps light the picture gallery in the Powers' Art Gallery, also in the same block. A steam engine in the basement supplies the power.

Seven miles from Rochester is the charming little port of Charlotte, which has now become quite a fashionable watering place for the Rochesterians. Here are two hotels, each having an isolated plant for 16 arc lights on the Brush system. These lamps light the Promenade, Pavilion, &c., as well as the hotels.

Travelling westward from Rochester, we may pass by Buffalo with its 300 Brush lights, and proceed to Cleveland (Ohio), the home of Brush, and the largest manufacturing city for electric light apparatus in the world. This city is lighted (or, rather, supposed to be lighted) by four enormous towers. These towers are constructed of boiler plates, rivetted together in the ordinary fashion. The diameter at the base is about 5 feet, and they are gradually tapered until a height of 260 feet is reached. As the diameter becomes less, two iron stays, which are fastened on each side of these towers or gigantic poles, gradually curve outwards from the centre to the top, so as to give stability in case of rough weather. At about 10 feet from the top of each tower a corona of eight Brush lamps of 4,000 nominal candle-power each is suspended. A small

gallery with iron railings around, at a height of about 20 feet from the ground, is also fixed to each tower, so that the corona can be lowered by a hand winch, and the lamps trimmed. A small iron ladder forms a ready means of access to this gallery. Altogether, these towers are very neat, and are a fine specimen of engineering. The effect, however, produced by the lights is unsatisfactory, and must have been very discouraging to the Brush Company. In fact, as far as lighting the city is concerned, this tower system is a complete failure. To place arc lights 150 feet high is quite bad enough, but it is infinitely worse to put them 250 feet high. Probably the lighting would be a little better if a reflector could be placed on the top of each corona of lamps, but even then the smoky atmosphere of Cleveland is not at all suitable for tower lighting. How different is the effect produced in Superior Street, which is literally flooded with light from the arc lamps outside the numerous stores.

The Thomson-Houston Company has a supply station in Cleveland, and appears to do a good business, judging by the number of lights in operation. With regard to the luminosity of the two lamps, it should be stated that the ordinary Brush lamp gives a more brilliant light than the Thomson-Houston, which is evidently stinted of current. A great deal has been written and said in praise of the Thomson-Houston system, but it is difficult to see wherein lies the superiority over the Brush. At the Boulton Carbon Company's works is a Gramme dynamo working eight Fuller arc lights, and a Thomson-Houston dynamo working three arc lights, on the same system; and it would be no exaggeration to say that the three-lighter takes up as much room as the eight-lighter. In fact, the Thomson-Houston dynamo is an enormous machine for the electrical output. The field-magnets are hollow, and contain comparatively little iron, which is used to considerable disadvantage. Were it not for the fact that the globular armature allows so much wire to cut the lines of force, the efficiency of the machine must be low. It would be interesting to know what quantity of copper wire has to be used in a Thomson-Houston dynamo to give a certain electrical output in comparison with other machines. It is easy to see that the machine must necessarily be an expensive one to build. The construction and winding of the globular armature must take up more time than would be required with other armatures. However, the machine has many novel points, and it does its work very nicely, so perhaps it will be well not to criticise too much. The automatic regulator, which alters the lead of the four brushes to suit the variations in the external resistance as the lamps are put in or out, is simple and ingenious, and also performs its work in a very satisfactory manner. The lamps on this system would be much improved if three or four ampères more current could be used with the same diameter of carbon. The mechanism of the lamp is not quite as simple as the Brush, although the principle is exactly the same, being a differential clutch lamp. The main magnet attracts one end of an armature lever which is pivotted in the centre, whilst the shunt magnet attracts the opposite end of the same lever, and in an opposite direction. The main magnet and shunt magnet cores are both coned so as to equalise the attraction on the said armature, which is correspondingly bored out at the ends opposite to the said cores. Usually the feed of the lamp is sudden. Looking at the mechanism of the Thomson-Houston and Brush lamps, there can be no reason in the world why one should not work just as well as the other, which, in fact, observation seems to prove. The light given out by the Thomson-Houston lamp is, however, more trying to the eyes than the Brush, and has a peculiar violet tinge, owing to the long arc and deficiency of current.

As far as carbons are concerned, the Boulton Carbon Company makes a large number of both plain and copper-coated, and is the largest carbon manufacturing firm in America, with the exception of the Brush Company, whose enormous works are close by. The American carbons are made in moulds, and not forced through a die, as in the French process. Copper-coated carbons are nearly always used in preference to the plain carbons.

Leaving Cleveland and arriving at Chicago, one is surprised to see the streets of this go-a-head city lighted by gas. The fact is, the municipal authorities, like those at Washington, have decided that no overhead electric light wires are to be used in the streets, so this is the reason. But, notwithstanding this decision, there are a vast number of isolated plants on the Brush, Weston, Thomson-Houston, Hochhausen, Fuller, Van Depoele, Sperry, and Western Electric Companies' systems. In fact, the electric lighting in Chicago is most interesting, since what has been done is of quite a permanent character.

The Palmer House, the most important hotel in the city, has an installation on the Weston system, consisting of about 50 Weston arc lights, which are used in the main entrance hall, billiard rooms, &c., and in some of the stores in the hotel block. The elegant barber's saloon of the Palmer House is beautifully lighted with nearly 100 incandescent lamps, which are suitably arranged in groups close to the elaborate ceiling, and are provided with ornamental opalescent shades. The proprietors of the Grand Pacific Hotel have adopted the Brush system. Sixteen Brush lights are arranged in the dining rooms, main entrance hall, and the corridors. In the Sherman House is to be seen an installation on the Van Depoele system. This arc lamp is of the clockwork type, but the light is not as steady as it might be.

In regard to theatres, it may be said that nearly all the principal theatres are lighted electrically. The Edison system is adopted at the Columbia Theatre, the lamps being very neatly arranged in the interior, whilst fourteen Thomson-Houston arc lamps illuminate the front of the building. In connection with this theatre is an art collection. Edison lamps are placed in screens over the pictures, which throw a beautiful light on the subjects, the lamps themselves not being visible. Another theatre which has adopted the Edison system is the Academy of Music, on the west side of the city, whilst three or four Hochhausen lamps are used to illuminate the exterior. Edison lamps to the extent of several hundred will also be used in the new Chicago Opera House shortly to be opened.

The lighting of the Grand Opera House in Clarke Street is very well accomplished by means of Perkins' incandescent lamps. This is a new lamp, with a filament shaped exactly like the Weston incandescent lamp. The arrangement of the lights over the auditorium is exceedingly neat, a very large lamp being in the centre with smaller lamps nicely grouped around it. The Perkins lamp seems to give a very pleasant light, and the lamps are very uniform in brilliancy. Another new incandescent lamp to be seen in Chicago is the Stanley lamp, manufactured by the Western Electric Company. This company has also a complete system of arc lighting on the patents of C. E. Scribner, the inventor of the multiple switch board so extensively used in connection with telephone exchanges. The arc lamps are of the clutch type, but the clutch and the disposition of the shunt and main magnets possess one or two novel features. The clutch itself is constructed of two halves, hinged at the top, so that when the striking mechanism comes into play these halves are closed in and grip the carbon holding tube to form the arc. Like the Weston, these lamps are worked with a heavy current and short arc. The dynamo is similar in appearance to the Weston, the armature being of the Siemens type. There is also a complicated arrangement to adjust the brushes on the commutator as the arc lights are turned on or off. The Western Electric Company's system does not appear to make much headway, probably because it is not so well known. Only a few lights on this system are to be seen here and there in different parts of the city, but the lighting of the Grand Union Depôt by means of 50 of these arc lights is already accomplished or in anticipation.

(*To be continued.*)

COPPER RESITANCE BY FALSE-ZERO METHOD.

By EDWARD RAYMOND-BARKER, Brazilian Submarine Telegraphs.

AMONG all the various methods for arriving at the true conductor resistance of a cable traversed by earth or by polarisation currents, the *false-zero* method stands pre-eminent. Whatever may be the E.M.F. of the earth current traversing a cable, so long as it remains fairly constant, and is not subject to very rapid variations, this method enables the operator to obtain similar and reliable results, whether with *positive* or with *negative* currents, whereas in a *scale-zero* test, if the earth current be at all strong, the result with one current will come out inordinately high, and with the other correspondingly low.

Now, it is known that in taking a C.R. test to *scale zero*, if results Z to L (R′) and C to L (R″) be fairly approximate, the *arithmetical* mean $\left(\frac{R' + R''}{2}\right)$ is exact enough for all practical purposes; should they, however, greatly differ, Mr. Dresing's formula for the *geometrical* mean $(\sqrt{R' R''})$ gives one—to use Mr. Dresing's own words—"the true, or about the true value." The *false-zero* method, on the other hand, obviates the use of all special formulæ, and being as correct in theory as it is simple and expeditious in manipulation, it has found great favour in the eyes of most cable operators. As far as the writer is aware, there is only one published explanation of this neatly-conceived test, and that one, it is almost needless to remark, is given by Mr. H. R. Kempe, who, according to his usual wont, subjects the conditions to algebraic analysis, and who, after having reduced his factors to the "bridge" formula, concludes with a few words descriptive of the practical arrangement of the test itself. The false zero test is mentioned, and directions are given for its manipulation, in each of the excellent and altogether extremely useful electrical pocket-books lately compiled, one by Messrs. Munro and Jamieson, the other by M. Hospitalier, but in either case—even in the latest revised editions—the text in respect to one important item of detail is vague and incomplete, and would be calculated to mislead any learner not *au fait* with the intricacies of practical cable testing.

The three last-mentioned gentlemen, not content with conferring a signal boon upon the electrical profession at large by the publication of these admirable *compendia*, have given expression in print to a hope that readers would, by their suggestions, co-operate with the authors, so as to make each successive edition of their works an improvement on the preceding one, and it is this circumstance which encourages the writer to intrude upon valuable space with the following remarks, the perusal of which, however, may not be wholly unattended with profit to the *learner* section of the "cable" confraternity. On the subject of the false-zero test Munro and Jamieson give the following:—

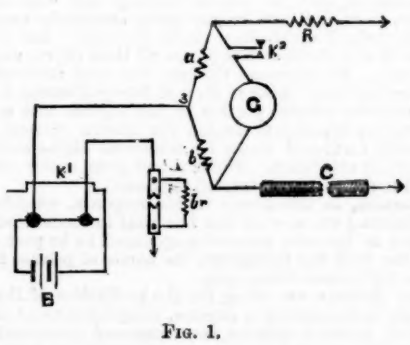

FIG. 1.

"1. Join up as in fig. 1, and obtain 'false-zero,' *i.e.*, deflection on G due to cable or earth currents. This is done by inserting a resistance, *b r*, equal to battery resistance between centre of bridge at 3 and earth; battery B being out of circuit, the earth current flows, on depressing K^2, partly through G to E.

"2. Cut *b r* out of circuit, and apply + or − pole of B by K^1, balancing R to the 'false-zero': when $X = R\frac{b}{a}$ the copper resistance of cable."

In Mr. Gordon Wigan's translation of M. Hospitalier's "*Formulaire Pratique de l'Electricien*," no mention is made of resistance, *b r*, but directions for a false-zero test are given as follows:—"Connections are arranged as if for a measurement by Wheatstone's bridge. The short circuit key of G is pressed, G deflects under action of earth current, and deflection is observed. The reversing (battery) key is then pressed down, and the resistance box is rapidly unplugged until the same deflection is reproduced; the resistance is then read. This method can only be used when the earth current is constant." Concerning the false-zero test Kempe observes:—

"If, therefore, we have a key so arranged that on depressing it a resistance equal to that of battery is inserted in the place of the latter, then on adjusting the resistances so that no alteration in the deflection of G is produced by the movement of the key, we get the value of *x* at once from the bridge equation." A diagram illustrative of such an arrangement is given in fig. 2.

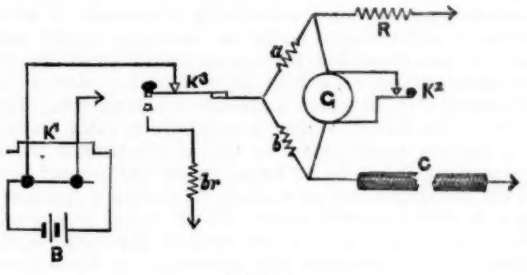

FIG. 2.

In practice, it will be found that in testing the copper resistance of a long cable, if B (the battery resistance) be low, as in the case of a battery of a dozen Leclanché's, it will not be actually necessary to make *b r*, equal to B; it may be made equal to zero without practically affecting the accuracy of the test. On the other hand, should a high resistance testing battery be employed, say 20 or 30 freshly set up Minotto cells, *b r* becomes necessary for the taking of a satisfactory test.

This question of substituting a resistance equal to that of B is, however, by no means the most important detail relating to the false-zero method.

The first two of the three descriptions above quoted appear to lose sight of the fact that upon the amount of resistance at R during the noting of the false zero depends the extent of the false-zero deflection. The first question asked by a learner on referring first of all to *Munro and Jamieson* and then to *Hospitalier* would be—"In order to observe false zero before applying B, *what resistance am I to unplug at* R?" For it is clear that if a false zero be noted on the scale with a certain resistance unplugged at R, immediately R is varied on its being adjusted after application of B, the position on scale of the false zero, as originally noted, must likewise vary. Also, if, when noting false zero the operator vary R, the false-zero deflection will likewise vary.

The question as to *what resistance ought to be unplugged at* R *during the noting of false zero* is answered by Kempe, who tells one to adjust *a*, *b*, and R, so that no alteration in deflection of G is produced by movement of key, K^3, that is to say, when once B has been applied by depression of K^1. Here, then, it is inferred that R is subjected to adjustment before the false zero can be observed, and granting that *a* and *b* are left fixed resistances, it will be evident that R has to be so adjusted that the movement of K^3 causes no alteration

in deflection on G. If this be done, it is clear that deflection on G remains constant whether K^3 be depressed, and $b\ r$ (if found necessary), substituted for B, or whether K^3 be raised, and either + or — pole of B be applied to bridge by reversing key, K^1; and the only problem that remains to be solved is that relating to the value to be given to R in order to produce this balance. It will presently be proved that this balance to false zero can only be obtained when $R : C :: a : b$, or, if $a = b$, R must = C, so that when the operator wishes to observe false zero previous to taking a test, he must unplug a resistance at R, which bears the same proportion to that of the cable, as resistance at a bears to that of b; on doing this, he will find that his false-zero balance is correct.

It is therefore obvious that, before a correct false-zero test can be taken, value C must be approximately arrived at by preliminary tests to scale zero with both currents, in the usual manner, in order to enable the operator to unplug at R a resistance duly proportionate to C.

To digress one moment from the subject in hand: would it not appear that Mr. Kempe in speaking of no alteration in the deflection of the galvanometer needle being produced *by movement of* K^3, has expressed himself in a way which might possibly be misleading to some learners? The writer may have misinterpreted the words quoted; in any case, he is surprised at his own temerity in presuming to question one word even from the pen of *the* authority on electrical testing. Mr. Kempe, however, is dealing with the question of "*measurement of the conductivity resistance of wires traversed by earth currents*," so that one would suppose his above-quoted directions would apply to the practical testing of cables in which the disturbing influences due to earth currents are invariably felt. If, then, Mr. Kempe's directions apply to cable testing, it is certain that, owing to the static charge which would rush into C on K^3 being raised (K^1 having been previously depressed) as well as to the static discharge from C which would ensue on K^3 being depressed, bridge and cable thus being earthed through $b\ r$, the taking of the false-zero test according to these directions becomes impracticable, the probabilities being, that if a learner were to act up to the letter of these instructions, it would be at the cost of his galvanometer suspension.

Might not the practical test be particularised as follows, Mr. Kempe's words being slightly modified? "If, therefore, we have a key so arranged that on depressing it a resistance equal to that of the battery is inserted in the place of the latter, then on adjusting the resistances so that a similar deflection on G is obtained whether the key be raised or depressed—due care being taken to short-circuit G during the raising and during the depression of key, so as to avoid disturbance due to static charge and discharge of cable—we get the value of C at once from equation $C = \frac{b}{a} R$."

(*To be continued.*)

THE FIGHT AGAINST THE BELL PATENTS.

WE give below the affidavit, taken from the *Electrical World*, of Mr. Wilber, formerly examiner in the United States Patent Office, upon which the National Improved Telephone Company is chiefly basing its proceedings against the Bell Company, as mentioned by us last week:—

City of Washington, } ss. [COPY.]
District of Columbia, }

Zenas Fisk Wilber being duly sworn deposes and says:

I reside in the City of Washington, in the District of Columbia, am 43 years of age, and am by occupation a solicitor of patents.

In the year 1876 I was employed by the Government of the United States as Principal Examiner of the Patent Office, in charge of the class of electricity. The application of Alexander Graham Bell for a patent for improvements in telegraphy, which was filed Feb. 14, 1876, which patent was issued on the 7th day of March, 1876, and numbered 174,465, was put in my charge as Examiner, and was passed to issue by me.

I reached the said application for examination on Feb. 19, 1876, and found on that day that a caveat had been filed by one Elisha Gray on Feb. 14, 1876, for a new art of transmitting vocal sounds telegraphically, which caveat, in my opinion, interfered with the first, fourth and fifth claims of Bell's said application.

On said Feb. 19, 1876, I notified Messrs. Pollock & Bailey, Bell's attorneys, that the first, fourth and fifth clauses of claims in said application relate to matters described in a pending caveat. Afterward, to-wit, on or about Feb. 24, 1876, the said attorneys, Pollock & Bailey, addressed a letter to the Commissioner of Patents wherein they stated that they had "inquired the date of filing of the caveat, inasmuch as we are entitled to the knowledge," and protested against the delay which the notice to the caveator would subject them to. They thereupon made a special application to the Commissioner of Patents, under whose instructions I afterward, to-wit, on Feb. 25, 1876, withdrew the suspension of the application.

I have since carefully examined the law on patents, and am satisfied that the notice to the attorneys of Bell of Feb. 19, 1876, is not warranted by law, and that their ascertainment of the date of filing Gray's caveat is also contrary to the letter and spirit of section 4,902 of the Revised Statutes.

To give such information to applicants for patents had to an extent become a custom in the Patent Office, but I now clearly perceive that the law did not contemplate the giving of such information to an applicant for a patent, as it distinctly requires the caveat to be kept secret, and the caveator alone to be notified.

On the 29th day of February, 1876, an amendment was filed by said attorneys for Bell and incorporated in the application, but to said amendment Bell did not make oath, nor did he subscribe to the same, as I verily believe.

Sworn and subscribed to before me this 30th day of July, A.D. 1885. ZENAS FISK WILBER.

Sworn and subscribed to before me
this 30th day of July, A.D. 1885.
JOHN E. BEALL,
Notary Public.

SEAL.

THE INVENTIONS EXHIBITION.

MESSRS. JAMES PAXMAN and Mr. T. J. Balls, of Colchester, on Saturday last gave a dinner in commemoration of the return of Sir Philip Cunliffe Owen, who has been absent for a long period through ill-health, and has now come back completely restored by his sojourn abroad. The ceremony took place in the Chinese Restaurant, from whence the best view of the illuminations can be obtained. Among the other guests were Sir Frederick Bramwell, Chairman of the Exhibition; Sir F. Abel, Chairman of the Electric Lighting Committee; Mr. R. P. Causton, M.P. for Colchester; and Mr. Augustus Adderley, C.M.G.

After the usual loyal toasts of the Queen and Royal Family, Mr. R. P. Causton, M.P., proposed the Executive Council of the Exhibition coupled with the name of Sir Frederick Bramwell, and expressing the pleasure it must give to all to see Sir Philip Cunliffe Owen enabled to resume once more his onerous duties. The executive were deserving of all praise.

Sir F. Bramwell, in reply, considered that every word of praise bestowed on them was no more than their due, and that the chief credit rested with H.R.H. the Prince of Wales, who selected the members, than whom it would have been almost impossible to find worthier or more skilled substitutes. Sir Frederick appropriately mentioned the great services rendered by Sir Philip Owen, and assured him that his absence was deeply felt by all classes connected with the Exhibition, and that little difficulties that had arisen would not have occurred had he been present, as all *contretemps* and hitches seemed to melt before his personalty, and that his marvellous powers of organisation had been greatly missed.

Sir Frederick Abel said that the electric light made the Exhibition a success, and the electric lighting staff were entitled to all honour, their skill and energy being absolutely necessary to the acknowledged satisfactory result obtained. But they must not forget that without motive power all their efforts would have been useless. He therefore thought that well deserved compliments were certainly owing to Messrs. Davey, Paxman & Co., who had supplied the greater portion of the engines and machinery for driving the dynamos producing the electric current, and who had, as well, furnished steam for numerous high-speed engines which were on exhibition. The firm had given entire satisfaction in regard to the portion entrusted to them.

Mr. Paxman, in the course of his response, considered that electric lighting was now on the fair road to commercial success, as the day of ignorant promotion appeared to be past, and that much of the work was falling into the hands of private firms who would no doubt make things pay.

[Messrs. Paxman are using for the production of the electric light at the Inventories five engines, comprising two double horizontal high pressure engines, two compound horizontal engines, and a double cylinder high pressure semi-fixed engine, these together working to 1,200 H.P. All these engines are fitted with Paxman's automatic expansion gear, which is very sensitive in its action under various loads.]

THE EFFICIENCY AND DURATION OF INCANDESCENT LAMPS.

(*Continued from page 252.*)

CALIBRATIONS were generally made by the dynamo currents, in default of a secondary battery. The currents used varied from one to two and a quarter ampères, giving from 21 to about 47 volts at the terminals of the standard coil. The calibrations were generally made with the same resistance in circuit of the potential galvanometer that was used in the measurements. The constant of the potential galvanometer was taken as the potential, producing a double deflection of one centimetre on the scale. Calibrations were made daily, and in case of any uncertainty were made before and after work. The value of the constant was obtained from formula

$$K = \frac{C\,R}{D}$$

where C is the current, R is the resistance of the standard coil at the temperature of the observation, and D is the double deflection of the mirror in centimetres of the scale.

It was found impossible to introduce a temperature correction with any degree of accuracy. The room was warmed by a stove, and on account of the low temperature of the building, it was necessary to keep a fire in it constantly. The temperature fluctuations, although not large in amount, were generally very sudden, and anything like uniformity of temperature was unobtainable. The temperature was recorded at first and the attempt made to reduce the values obtained to a standard temperature, but the reductions were found to be of no utility. The temperature of the room ranged between 11° and 23° C. Calibrations were not made at the low temperatures, but the room was heated and kept warm for some time before calibrating. The range of temperature of the coils, while measurements were being made, was probably not more than 7°, involving an extreme possible error, from inability to determine the temperature correction, of $\frac{3}{10}$ per cent.

MEASUREMENTS OF EFFICIENCY.

The general method of making the observations for efficiency has already been stated. The committee aimed to test each lamp at its normal potential as stated by the makers, and to place it in the test for duration at the same potential, that the relation between efficiency and life might be traced. A few lamps were tested at two or more potentials. The efficiency measurements were begun at the earliest moment when it was thought that the arrangements for the test were sufficiently advanced to secure good results.

The constant of the potential galvanometer had been determined from only a few calibrations, and the error of the tangent galvanometer was not known as well as it was later in the test. Owing to the chemical action of the turpentine on the German silver of the standard coil used in calibrations for potential, the resistance was under estimated and the potential constant determined by calibrations was too small. After the efficiency measurements were all completed, the observations were recalculated, allowing for all known errors as determined by later measurements. The result was to raise the potential in almost every case above what was thought to be its value at the time the observations were made. In the following tables the potential is that at which the efficiency measurements were made as determined by the corrected calculations.

The diagrams* show the curves of illumination in five planes passing through the centre of the lamp. The first is a horizontal plane, the equator, the others marked "vertical" are vertical planes, making angles of 45° apart. The black line in each circle shows the plane of the shanks of the carbon; the parallel lines at 0° of each circle represents the position of the photometer bar. The circles are drawn with a radius of 16 of the scale of candle-power. The following points on the different circles are coincident.

0° on horizontal and 0° on vertical 0°.
90° on horizontal and 0° on vertical 90°.
180° on horizontal and 180° on vertical 0°.
270° on horizontal and 180° on vertical 90°.

The four 90° points on the vertical sections represent the light given off at the top of the lamp.

The four 270° points in the vertical sections correspond to the base of the lamp.

The horizontal distribution is found in all the lamps tested to be dependent on the cross section of the carbon. If this is circular as it is in the Stanley and White lamp, the curve of horizontal illumination is practically a circle; if rectangular, as in the Edison and Woodhouse and Rawson, the greatest illumination is given in that direction towards which the longest side of the rectangle is turned.

Lateral twist causing the major axis of a rectangular cross section to lie in different directions at different heights in the lamp, produces a marked effect as is seen by the curve of the Weston lamp. The light given off at the top of the lamp depends in the same way on the amount of illuminating surface visible from that point. In the Edison lamp, which has a long carbon, the two branches being comparatively close together, but little illuminating surface is visible from the top of the lamp, and but little light given off. In the Weston lamp, however, the carbon is bent into a curve, more closely approximating to a circle, and the lateral twist given the carbon turns the long side of the rectangle in the middle of the loop towards the top. These two causes result in turning a considerable illuminating surface in that direction, and consequently in giving a large proportion of light.

The committee is indebted to Mr. C. H. Small, of the University of Pennsylvania, for the averaging of results and the construction of the light curves.

RECORDS OF AVERAGES OF 20 LAMPS.

Efficiency Test of the Franklin Institute Preliminary to the Duration.

Maker's Name	EDISON.
Mean Potential—volts	97·9
„ Current—ampères	·969
„ Power—watts	69·41
„ Watts per spherical candle ..	4·48
„ Spherical intensity—candles	15·49
„ Standard reading	16·53
„ Reduction factor..	0·94
„ Resistance cold	2·48

RECORDS OF AVERAGES OF 10 LAMPS.

Efficiency Test of the Franklin Institute Preliminary to the Duration.

Maker's Name ..	WOODHOUSE-RAWSON.
Mean Potential—volts	55·48
„ Current—ampères	1·026
„ Power—watts	56·92
„ Watts per spherical candle ..	3·56
„ Spherical intensity candles	15·99
„ Standard reading	14·9
„ Reduction factor..	1·00
„ Resistance cold	·115

RECORDS OF AVERAGES OF 10 LAMPS.

Efficiency Test of the Franklin Institute Preliminary to the Duration.

Maker's Name	STANLEY.
Mean Potential—volts	96·4
„ Current—ampères	·551
„ Power—watts	53·11
„ Watts per spherical candle ..	3·92
„ Spherical intensity—candles	13·56
„ Standard reading	16·27
„ Reduction factor	0·85
„ Resistance cold	34·9

RECORDS OF AVERAGES OF 10 LAMPS.

Efficiency Test of the Franklin Institute Preliminary to the Duration.

Maker's Name	WHITE.
Mean Potential—volts	49·99
„ Current—ampères	1·017
„ Power—watts	50·83
„ Watts per spherical candle ..	4·08
„ Spherical intensity—candles	12·44
„ Standard reading	14·83
„ Reduction factor	0·84
„ Resistance cold	92

RECORDS OF AVERAGES OF 10 LAMPS.

Efficiency Tests of the Franklin Institute Preliminary to the Duration.

Maker's Name	STANLEY.
Mean Potential—volts	43·98
„ Current—ampères	1·053
„ Power—watts	46·32
„ Watts per spherical candle ..	3·45
„ Spherical intensity—candles	13·42
„ Standard reading	16·7
„ Reduction factor..	0·80
„ Resistance cold	81

RECORDS OF AVERAGES OF 20 LAMPS.

Efficiency Test of the Franklin Institute Preliminary to the Duration.

Maker's Name	WESTON.
Mean Potential—volts	111·4
„ Current—ampères	·530
„ Power—watts	59·04
„ Watts per spherical candle ..	3·63
„ Spherical intensity—candles	16·27
„ Standard reading	19·73
„ Reduction factor	0·82
„ Resistance cold (15 lamps) .	407

EDISON LAMPS.

Although only 23 lamps were required to be measured for the duration test, a larger number were examined and the efficiency results appended. The first 20 of the lamps were tested for duration, and the curves in the diagram were calculated from them. But few peculiarities were observed in these lamps. One, through a peculiar distortion of the carbon, gave an almost circular curve of horizontal distribution, but the curves of the others were essentially the same as in the diagram. Owing to the causes already mentioned, the potential of the lamps is generally $\frac{7}{10}$ths of a volt higher than the normal. The lamps were taken at random from 400 furnished by the company.

STANLEY-THOMPSON LAMPS (96 VOLTS).

Fourteen of the 96-volt lamps were tested for efficiency, four of the original having been broken in fitting them to sockets preparatory to the test for duration, and four others tested in their places. The curves are the averages of the first 11 lamps, and the averages are those of the first 10. The lamps were taken from a lot of 50.

STANLEY-THOMPSON (44 VOLTS).

These lamps gave the highest average efficiency of any lot under test, but varied considerably from each other. The curves are essentially the same as those of the 96 volt lamps, except in giving less light at the top of the lamp. The lamps were taken at random from a lot of 50.

WOODHOUSE AND RAWSON LAMPS.

Two lots of these lamps were tested. The results obtained were generally the same. The first lot were marked 55 volts, and were taken from 25 lamps furnished. The slight irregularities in the curves are due to the fact that the lamp was mounted on a spring socket (Swan) in the efficiency measurements, and the motion and vibration of this socket in moving it through the various positions

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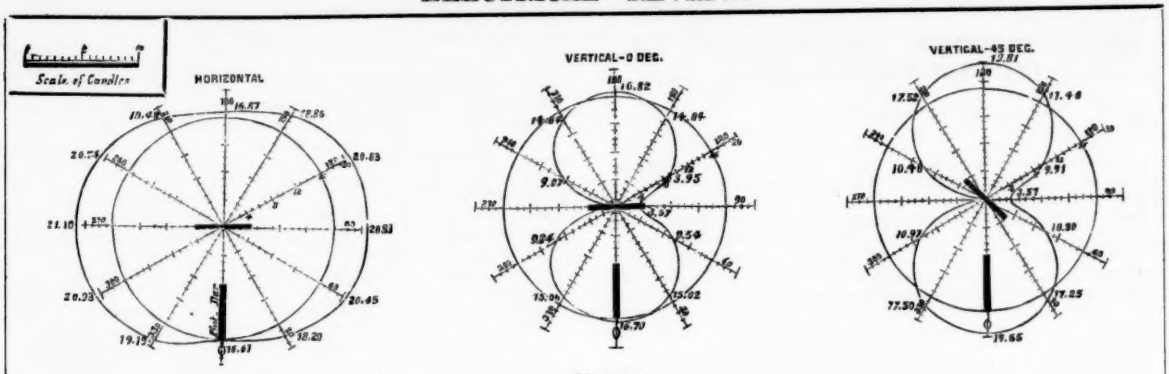
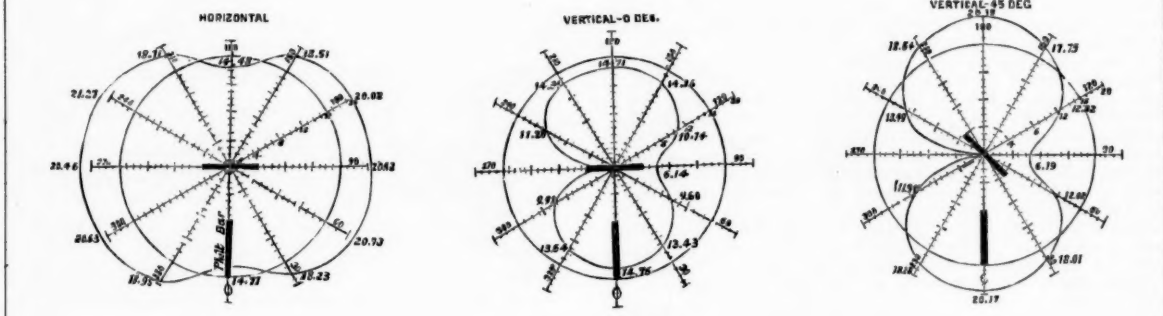
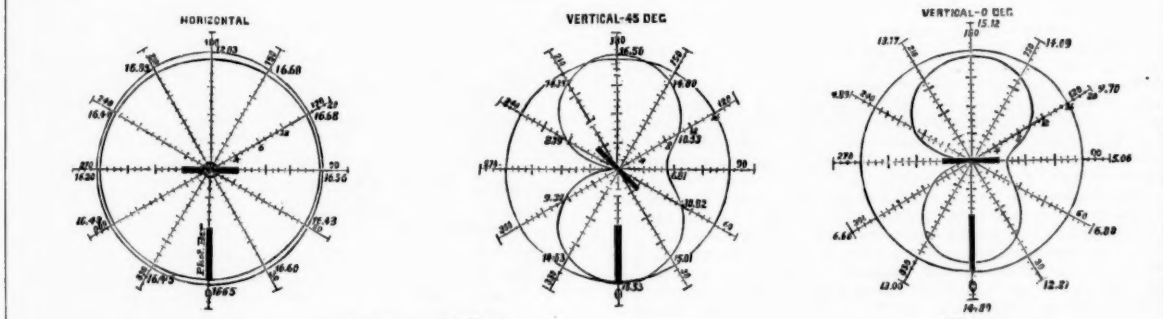
* There are six plates of diagrams, two being given to the Stanley-Thompson system for 96 and 44 volt lamps respectively. We reproduce the curves of illumination of each lamp—excepting the low E.M.F. Stanley—in the horizontal plane, but in the vertical planes we give only the following:—Edison, 0° and 45°, the 90° and 135° being very similar to the 45° diagram. Stanley, 96 volt. lamp, 45°, the remainder being almost exactly the same. Woodhouse and Rawson, 0° and 45°, the remaining two being very similar to this last. White, 0°, the others being much alike in character. Weston: of this lamp we give all the diagrams, as they differ in every plane.—EDS. ELEC. REV.



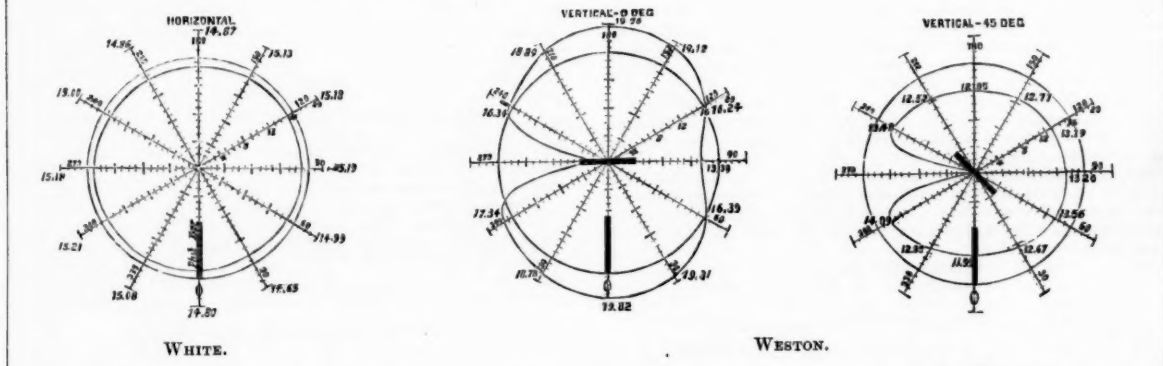
EDISON.



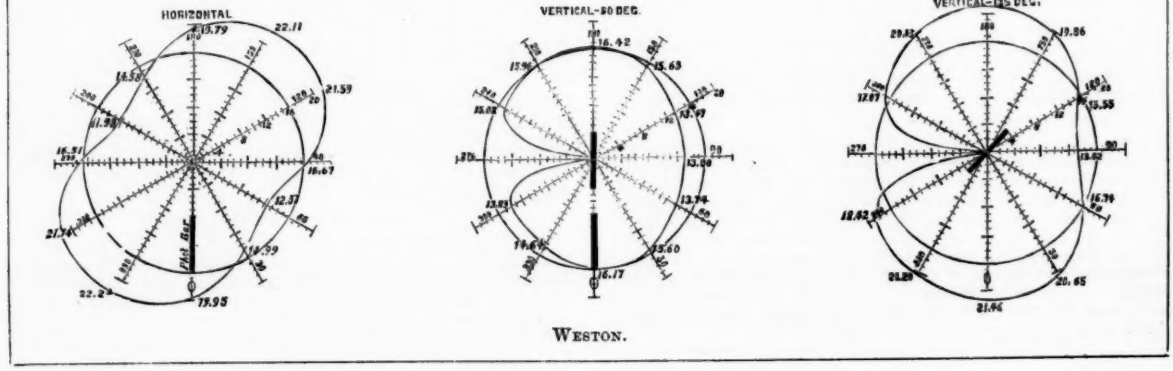
WOODHOUSE AND RAWSON.



STANLEY—96 VOLT. WHITE.



WHITE. WESTON.



WESTON.

occupied prevented as accurate measurements as in other cases, where the lamp was held rigidly.

The second set of Woodhouse and Rawson lamps, selected from 50 furnished, were marked 50 volts, and a paper accompanying them from the makers invoiced them as "20 candle-power, 50 volt" lamps. They were tested by the committee, as the duration test on the former lot was unsatisfactory by reason of many of the lamps being connected two in series. On setting the new lot up at 50 volts, they were found to give only 12 spherical candles, and to have an efficiency of about five watts per candle. The Woodhouse and Rawson is known as a very economical lamp, and has of late attracted much interest on that account. A duration test of 300 hours was all that could be allotted to these lamps, and would determine nothing if the lamps were tested at so low a candle power. As the resistance of the lamps cold was the same as some of the first lot of 55 volts, the committee determined to test the second lot at that potential also, with a statement of the facts.

WHITE LAMPS.

These lamps were taken from a lot of twenty-four. The carbon is apparently made of thread, has a circular cross-section, and is heavily treated. The curves of the whole lot are almost identical. The lamps were tested with spring sockets received from the Electrical Supply Co., and to the vibrations and lack of rigidity of this socket during the revolutions of the lamp holder, is attributed the slight want of symmetry observable in the curves. The cold resistance in the table of the figure is unquestionably an error, but was not discovered until too late for correction. The lamps decreased in resistance during the duration test. The average cold resistance before use of several lamps of the same lot was found to be 102 ohms, and those under test probably averaged about the same.

WESTON LAMPS (110½ VOLTS).

In submitting a report on the tests of these lamps the committee think it proper to give a resumé of correspondence between Mr. Weston and themselves. The 110½ volt lamps were received from the United States Company in January. Efficiency measurements were made on the 5th, 6th and 7th of February. On the 18th of February Mr. Weston visited the exhibition building, was shown the results of the efficiency measurements on his lamps, examined into the installation and the working methods of the test, and, thinking the candle-power of some of them low, addressed the following to the committee :—

Philadelphia, *February 18th*, 1885.

Having examined the methods of testing used and the results obtained in the efficiency determinations, I would request a re-measurement of my lamps numbered 4, 6, 15 and 17.

I am satisfied that the methods used are such as will produce correct results.

EDWARD WESTON.

The lamps designated were re-tested, and the accuracy of the former measurements verified. On the 7th of March the preliminary run for working methods began. Owing to irregular working of the engine, causing flickering in the lamps, it was prolonged a week, that better working might be secured. On March 17th the committee had arranged to begin the duration test at 2 p.m. Very shortly before that time, the representative of the United States Company, who had not been in attendance on the tests for several weeks, although his presence had frequently been solicited, arrived with the following letter from Mr. Weston :—

Laboratory of Edward Weston, 107, Orange Street,
Newark, N.J., *March 16th*, 1885.

Prof. WM. D. MARKS.

Dear Sir :—The very marked difference in candle-power of our lamps, as shown in the tabulated results of the tests made in Philadelphia, surprised me very much, particularly as our lamps are remarkably uniform in this respect, and must necessarily be so when properly made, owing to the peculiar method of treating the loops.

After arriving here I commenced to investigate the matter, and soon found that you had been supplied with a singularly bad lot of lamps; the defect being due to imperfect baking of the loops. This has been so imperfectly done that you will find it impossible to maintain the candle-power uniform for even a very short period of time without increasing the E.M.F. The resistance of the loops will rise rapidly, and the lamps will rapidly deteriorate and fail in such a short time, as to leave no doubt in your mind that if we made such lamps regularly, we could not possibly continue to do business. In other words, the lamps are thoroughly worthless.

In view of these facts I think it is useless to spend any time on the lamps of our make which you now have, and since there is no provision in the code for such a contingency as has arisen, I respectfully submit this statement of facts to the committee, and ask for a careful consideration of the matter.

Deeply regretting that anything should have occurred on our part to still further prolong and increase the cost of a series of tests which must necessarily be very tedious and expensive, I remain,

Yours respectfully,
EDWARD WESTON.

The members of the committee present agreed with Mr. Weston that the code provided no remedy for a case of this kind, and agreed to postpone the beginning of the test and to refer the matter to the Edison Company, that the competing parties might enter upon new arrangements. The Edison Company, through Mr. Upton, agreed that Mr. Weston should have the privilege of entering another lot of lamps of the same general character and grade as those already tested, and the committee desirous of obtaining good lamps for test, agreed to measure them when received. On the 1st of April a conference took place between Messrs. Weston and Upton, the President of the Franklin Institute, and a portion of the committee, at which Mr Weston stated he thought there would be no doubt but that the new lot of lamps would be on hand within a week. The allotted time expiring without anything being heard from him, the following letter was sent :—

Philadelphia, *April 8th*, 1885.

Mr. EDWARD WESTON,
Electrician of the U.S. Electric Light Co.,
Newark, New Jersey.

Dear Sir :—Since your letter of March 16th, 1885, the committee of the Franklin Institute appointed to conduct the competitive duration test of electric incandescent lamps have been awaiting the receipt of other lamps to replace those which in your letter you condemned and pronounced worthless. Our letter of the 17th ultimo conveyed to you an expression of our willingness to undertake the additional labour necessary to test a new lot of lamps. Hearing nothing further from you regarding lamps, we telegraphed for date, and received no reply, on March 26th. On March 30th, a fortnight later than your letter, we wrote to say that the tests would begin April 3rd, unless some sufficient reason for delay was assigned. At our verbal conference of April 1st, our understanding was that your new lamps would certainly reach us by to-day. We again telegraphed you yesterday afternoon. The engagements of some of the members of the committee will prevent the completion of the duration test if further postponement occurs. In justice to the Franklin Institute this test must be completed.

The committee in the absence of any reply relative to our telegram of yesterday, feel compelled to fix Saturday the 11th, current, as the date beyond which further postponement is impossible. This will have given you twenty-five days in which to replace lamps pronounced worthless in your letter of 16th March. The committee have stretched the allowable time of delay to the utmost and regret the imperative necessity which forces them to fix a limit to it.

The committee interprets your letter of the 16th as a withdrawal of your lamps of the 40 grade (110½ volt).

If new lamps of similar grade are not received by Saturday forenoon, April 11th, the duration test will proceed without your lamps and the United States Electric Light Company will not be regarded as a competitor. The 70 volt lamp now measured will, however, be tested as a matter of scientific interest, but not in competition with other lamps.

We regret that circumstances force us to make this decision, and will be more than pleased to have you enter as a competitor. Our limited time and means will not permit further delay.—I am very truly yours,

WM. D. MARKS.

This letter was written with the knowledge of only a portion of the committee, who assumed that the Edison Company would not compete with lamps pronounced worthless by their maker.

On April 9th another conference was held at which the representative of the Edison Company objected to Mr. Weston withdrawing his lamps, and addressed the following letter to the committee :—

Prof. WM. D. MARKS, *Chairman.*

Dear Sir :—The Edison Company desire that the test of lamps be proceeded with under the code without further delay.—Respectfully,

FRANCIS R. UPTON.

65, Fifth Avenue, *April 9th*, 1885.

This request that the test should be continued under the code, the failure of Mr. Weston to provide new lamps, together with the impossiblity of further delay if the test was to take place at all, gave the committee no option but to proceed under the code with the lamps on hand. In order to prevent any misunderstanding on the part of Mr. Weston, he was notified by letter and telegram that the test would begin on the 11th. A few hours after the beginning of the test the following telegram was received :—

Prof. WM. D. MARKS.

Your telegram surprised me. The lamps have been withdrawn. Our position in this respect is fully caused by your letter of April 8th. I presumed that this was the final judgment of the committee pending a reply from me. There is no clause in the code by which the Edison Company can compel the committee to proceed as indicated in your telegram, neither the committee nor the Edison Company have any right to re-enter our lamps without our consent. My letter in reply to yours of the 8th will fully cover these points.

EDWARD WESTON.

The matter was immediately considered by the full committee and answered as follows :—

Philadelphia, *April 11th*, 1885.

EDWARD WESTON, Newark, New Jersey.

In reply to your telegram of to-day the committee have considered the question you raise. It was understood by them that the verbal conference of Thursday evening, at which you were present, made it clear that the formal demand of one of the competitors that the test should proceed, left the members of the

committee then present no option in the matter, and rendered the letter of the 8th nugatory. Under the provisions of the code any questions between the contestants and the committee can be settled by a unanimous vote of the committee, and the undersigned give their decision that under the code no withdrawal is possible, and their letter of the 8th becomes invalid when questioned by a contestant.

J. B. MURDOCK, G. M. WARD,
L. DUNCAN, WM. D. MARKS.

Subsequently another letter was received from Mr. Weston and another conference held at his request, but the committee regarded their action as final, and nothing was done.

The committee present the above as a matter of justice to Mr. Weston, and also as an explanation of their own course of action.

Reference has already been made to the peculiar form of the Weston carbon. The light curves were very similar in form in all the lamps. In one the major axis of the curve of horizontal illumination lay in the direction of 30°—210° instead of in 330°—150° as in the figure. In making up the average of 20, another lamp was substituted for this one.

The results of the preliminary efficiency measurements are given in the tables and diagrams.

WESTON LAMPS (70 VOLTS).

Mr. Weston having expressed a desire to have measurements made on a lot of 70-volt paper carbon lamps, they were entered by the president of the Franklin Institute for test. The distribution of light is almost exactly the same as in the other lot. Ten lamps were selected from a lot of 33 received from Mr. Weston, tested for efficiency, and afterwards subjected to a duration test of 523 hours.

In addition to Mr. Weston's approval of the methods adopted in the test, as stated in his letter of February 18th, the committee received the following :—

Philadelphia, *March 6th*, 1885.

Having examined the methods of testing used and the results obtained in the efficiency test now being made by the Franklin Institute, I am satisfied that the methods used are such as will produce correct results.

FRANCIS R. UPTON.

Philadelphia, *February 13th*, 1885.

Having been personally present during the determination of the efficiency of the lamps entered for the duration test, and having examined the instruments used, the methods pursued, and the operations of the experimenters, I am of the opinion that the tests are fairly conducted, and that the methods used are such as to produce correct results.

JOHN W. HOWELL.

(To be continued.)

SPECIAL TOOLS FOR ELECTRICAL INSTRUMENT MAKING.

THE well-known firm of Messrs. Smith, Baker and Co., Cornbrook Telegraph Works, Manchester, have recently placed in the market a number of special tools peculiarly adapted for electrical workshops, where it is necessary to produce work of a very high class finish, and with a rapidity that can only be accomplished by means of special appliances. One of the most useful of these tools is a moulding machine.

By its means, and with practically no skilled labour, cabinet work and fittings of the highest class can be easily and very quickly turned out. The machine is fitted with a rising and falling spindle to mould any height up to four inches, any kind of moulding, both inside and out and round corners, rebating and grooving being readily effected. A new method of holding the tools, by which they are given a lead, is adopted, so that there is no tearing of the wood, and this leaves the moulding very clean and sharp.

A vertical drilling machine is the subject of the next notice, and fully meets the requirements felt for a high speed tool of this class.

The apparatus is really an improvement upon a somewhat similarly designed machine already in the market, but it is larger, stronger, and far better qualified for practical work. The bearing of large driving wheel is adjustable by means of a screw and slot, which admits of the band being readily tightened up.

The machine is designed to drill in brass and iron up to §-in. hole, the stroke of drill is three inch, and the depth of cut is regulated by a balanced arm and stop. The table for holding work being carried on a vertical pedestal, can be swung round, raised or lowered at pleasure.

The next machine calling for special attention, and on which many improvements have been developed, is a circular saw.

This machine is most substantially and rigidly constructed, and is specially adapted for sawing in either wood or metal. The table is pivotted at the front, and rests at the back on a vertical screw, the bandwheel of which, on being turned, raises or lowers the table, and by this means different cuts are obtained. Provision is made for using cutters for metal work.

The last calling for notice is a special lathe with four inch centre.

It is throughout a very highly finished tool. The mandril is of hardened metal, and runs in a hardened steel collar; there are, a four foot gap bed, compound slide, and T rests, and the latter is fitted with a dividing headstock and stop. An extra large six speed flywheel is provided for working with a treadle, and for power an overhead pulley arrangement, with reversing gear to facilitate tapping. This lathe is of a high-class, and particularly well adapted for fine work.

NOTES.

The Electric Lights at Blackpool.—The electric lights on the Promenade and piers at Blackpool were suddenly extinguished on Tuesday night last week, the cause being the bursting of a 4-inch water pipe in Victoria Street, where the electric light depôt is situated. The leakage having been repaired, and the water supply to the engines having been made good, the dynamos were again set running and the lighting re-established.

Electric Lighting in Mills.—In an article on "Cotton Mills and Electric Lighting," the *Mechanical World* says :—"If in building new mills the directors of limited companies and gentlemen with capital were to enter thoroughly into the question of the merits of the two systems of lighting, they would without any doubt prefer that of the electric light; but would they uphold their 'conviction?' If they did they would never repent their decision. It is in the cases of new mills where the greatest advantage may be obtained, and in such an instance as that of a new cotton mill now commencing to be built in Portwood, Stockport, the electric light might be applied with the greatest advantage and economy. The mill contains about 75,000 spindles, and will form the first portion of a scheme prepared by the Palmer Mills Co., Limited, for the erection on the site of the old Palmer Mills of a modern mule spinning concern of about 140,000 spindles, with accommodation for some 10,000 ring throstles, or doubling spindles, the building of a second mill being included in the scheme. It has been hoped that Stockport would again occupy a foremost place in the centre of the cotton industry; in this hope the establishment generally of the electric light would be an assistance."

The Thomson-Houston System.—The Thomson-Houston Electric Company has recently received an order for 90 arc lights, to be immediately installed in Washington, D.C. A large order is anticipated from Portsmouth, O., where 45 arc lights have already been put in. At the new electric light station at Milford, Mass., there will be 45 Thomson-Houston arc lights and 300 Brush-Swan incandescent lights. The plant will be fitted with a 60 H.P. Armington and Sims engine. 39 Thomson-Houston arc lights have just been installed in Halifax, N.S.

Economy of the Electric Light.—The report of the custodian of public buildings in St. Louis for August, shows a saving of $536 for that month by the use of the United States Electric Light Company's incandescent light in Custom House and Post Office.

The Ball Electric Light Company.—This Company, through its New England agency, is at present engaged in installing a 90 arc light plant in the Providence worsted mills. A contract has also been entered into with the Philadelphia Cyclorama for a plant of 40 arc lights.

American Electric Light Association. — Mr. Frank Ridlon, chairman of the committee on carbons in connection with the National Electric Light Association of America, is preparing actively for the next convention, and is now making arrangements for securing the best and most uniform system of testing carbons.

Mr. Charles Lever on Electric Lighting in the United States.—Upon the first article from Mr. Lever's pen, which appeared in our columns a fortnight ago, *Invention* makes the following comments:—"In the current issue of the ELECTRICAL REVIEW, Mr. Charles Lever, the young inventor of the Lever arc lamp, commences a graphic account of electric lighting in the United States, from experience gathered during his travels in that country. Now, Mr. Lever's lamp is certainly a very simple and ingenious contrivance, but when he goes in for criticising the electric doings of our American cousins he is treading on somewhat tender ground. Thus the following account as to American doings is evidently overdrawn, for our Yankee cousins are too shrewd to allow such occurences to happen habitually as Mr. Lever appears to suggest. 'Overhead wires conduct the current to these lamps, which dangle about everywhere. Frequently one of these electric light wires comes into contact with a telephone or telegraph line in such a way that a dozen telephone or telegraph instruments are burned in consequence; but, of course, this is "an accident." In a few days all business is resumed, everything proceeding as before.' Mr. Lever also considers the Edison machine, which is turned out under the management of his 'good friend,' Mr. Charles Batchelor, at the Edison machine works, in Goerck Street, New York, almost perfection. In fact, according to Mr. Lever, there is no incandescent light dynamo in this country which can vie with these improved Edison machines in workmanship or efficiency. The criticism, it will be seen, is somewhat sweeping. Mr. Lever's essay, however, is, on the whole, brightly written, and will be found to contain a good many interesting points."

The Electric Light at Guy's Hospital.—A *soirée* took place at the above hospital on Thursday last, when the rooms were successfully lighted with Woodhouse and Rawson's incandescent lamps worked off Faure-Sellon-Volckmar accumulators delivered on the morning of the *soirée*. The installation was a very scattered one, 900 yards of main lead alone being used. Notwithstanding that the lighting was merely temporary, and that but short time was allowed for completion, the work was very well done, no wires being noticeable except where the lamps arranged as pendants hung down from the ceiling, suspended by gold and red silk cord. The installation was put up by Messrs. Woodhouse & Rawson, of 11, Queen Victoria Street, who also, as exhibitors, showed some very useful and interesting medical appliances, including their application of small incandescent lamps for illuminating the interior of the human body. Of these they have various forms of laryngoscopes, dental and throat lamps. In the former a small incandescent lamp illuminates the mirror instead of the method of reflecting the light from a cumbersome oil lamp or candle being employed, the light being turned off or on at pleasure by a simple external switch worked by the thumb at the centre of the holder. The intensity of the light is increased or diminished by sliding a movable ring up and down a coil of German silver wire wound spirally round the handle. Messrs. Woodhouse & Rawson also exhibited a portable electric bull's eye, which is either fixed by a hook in the button hole, or can be held so as to illuminate any portion of the body under examination.

Lighting of the Training Ship "Exmouth."—On Tuesday last the electric light cable which is to connect the training ship *Exmouth* moored in the Thames off Grays, with the engine and machine rooms on shore, was successfully laid. The undertaking was witnessed by Mr. Albright of the firm of Messrs. Crompton & Co., who are carrying out the lighting, and Mr. Phillips of Messrs. Phillips Bros., who supply the cable. The chief officer with smart boat crews composed of the boys from the ship, lent useful assistance. In spite of a strong tide and bad weather, the laying of the cable, some 1,500 feet in length, was successfully accomplished. The installation, which is approaching completion, will be one of about 250 lights.

Attending Church by Telephone.—An interesting illustration of the development of the telephone was afforded last Sunday by Mr. Northam, the local manager of the National Telephone Company, at Sheffield. The telephone wires between Sheffield and Bradford were extended to St. Paul's Church, Manningham. A number of ladies, with several members of the Town Council and other gentlemen, had the gratification of listening, at the telephone company's office, Change Alley, Sheffield, to the morning and evening services in the church at Manningham. The Change Alley congregations numbered fifteen in the morning and eighteen in the evening. At the same time between sixty and seventy of the company's subscribers in Bradford and Huddersfield were listening to the same services. The lengths of the wires were 66 miles and 132 miles respectively. A "Blake" transmitter was fixed on the pulpit; another was placed on the reading desk, and a third on the lectern. These instruments are permanent fixtures, to enable invalids and others to listen to the church services at Manningham from their residences on any Sunday. At the conclusion of each service the "congregations" assembled at Sheffield expressed their hearty thanks to the employés at Manningham, Huddersfield, and Sheffield for the interesting experiments of the capabilities of the telephone in use.

Telegrams to Buenos Ayres.—An "English Resident" at Buenos Ayres writes to the *Times* that the telegraph companies insist on charging Buenos Ayres as two words, although San Francisco is allowed as one. The latter is transmitted as "Frisco," but the companies refuse to accept an abbreviation of Buenos Ayres. The charge per word is 10s.

Sixpenny Telegrams. — A correspondent of the *Standard* complains that "Mile End" is charged as two words in the address of the new sixpenny telegram, and suggests that Gravesend, Whitechapel, Blackwall, and scores of other districts should on the same principle represent two halfpence instead of one.

Classification of Telegrams.—"Clara Fletcher Moulton" writes to the *Times* suggesting the use of "open" and "private" telegrams in addition to the ordinary closed telegram; the former to indicate that the contents were not specially important and might be read by a servant or others, and the latter that it was to be opened only by the person to whom it was addressed. Certain advantages were pointed out.

Telegraph Linemen.—Under the heading, "A Plea for our Linemen," a letter appears in the current issue of the *Telegraphist*, detailing the hardships which linemen have to endure, and the scant opportunities of recruiting health and strength which they possess.

Proposed Dinner of Old Telegraph Companies' Employés.—It is suggested that an effort should be made amongst the old servants of the Magnetic and United Kingdom Telegraph Companies to have a dinner during the Christmas holidays in some central city.

Alleged Extravagance in the Telegraph Department.—The *Telegraphist* asks:—"Can the probable loss in the destruction of stationery in connection with the introduction of the sixpenny rate be ascertained or estimated? Why are the old forms destroyed? Are they not quite as adaptable to the new rate as those promulgated for that purpose? It is not to be wondered at the department failing to pay, when such reckless extravagance is carried on. Gone are the heads of the old companies; they would not have allowed such wanton destruction of assets. Is it not time the Telegraph and Postal Departments were under separate control?"

The Telegraph in Central Asia.—We have received a pamphlet from Mr. C. E. Pitman, C.I.E., Chief Superintendent of Telegraphs, Simla, which embodies remarks made by the author at a meeting in 1881 of the Society of Telegraph Engineers and Electricians, and articles and correspondence which have appeared in the *Pioneer* during the present year, all pointing out the advisability and possibility of restoring the telegraph line to Candahar, and extending it to Herat; a further extension from Herat to Meshed seems also to be suggested. The military and political importance of such a line is very ably dwelt upon.

Improved Telegraphic Facilities at Portsmouth.—In response to numerous representations the Postmaster-General has decided to increase the existing facilities for sending or receiving telegrams, by directing that the central telegraph office at Landport shall in future be kept open continuously night and day—a boon that will be greatly appreciated by the trading community of the town as well as by the press. The new order came into operation last week on the same day as the new system of sixpenny telegrams was inaugurated. Hitherto the principal offices for telegraphic purposes have been those in High Street, and on the Common Hard, but it was felt that under the new state of things the chief office should be in a central part of the town. The new postal telegraph office which has been erected in the populous Commercial Road, opposite the principal railway station, was accordingly selected as the headquarters of the telegraph department, and thither a short time since many of the instruments from the other offices were conveyed. Between the Portsea office and London there is now only one wire. In order to carry out the scheme of centralisation with ensured success, it was decided to build another storey to the new office, and this work which has been carried out by Messrs. Bull, of Southampton, has just been completed. The new apartment, which is 50 feet by 30, is spacious, lofty, well lighted, and properly ventilated. Here numerous extra instruments have been fitted up, including a quadruplex. The press telegrams both to and from London form a very important item in the work of the telegraph officials at Portsmouth, and for "news" there is a special Wheatstone transmitter. The staff will shortly be augmented by six or seven female operators, and the messenger staff will also be largely increased. The counter is connected with the instrument room by means of pneumatic tubes, one tube being used for sending messages up for transmission, and the other in sending them down to the counter. At the back of the offices residences are being erected for the Telegraphic Inspector, and the lineman belonging to the Royal Engineers. A battery room is also being built.

Russian Press Telegrams.—The special correspondent of the *Novoe Vremya* now in London writes to his paper that his telegraphic despatches to St. Petersburg respecting the Roumelian revolution, have not been sent, and, in fact, complaining that a censorship has been established over foreign Press telegrams. There must, of course, be a mistake somewhere, but the difficulty will be to convince the Russian Press of that fact.

Isle of Man Telegraphs.—The sixpenny tariff, which was inaugurated in the Isle of Man by a telegram from his Excellency the Governor to the Postmaster-General, thanking his lordship on behalf of the Island, for the reduction of the tariff, is likely to prove highly remunerative to the Post Office. At the close of the first day it was ascertained that there had been an increase of 70 per cent. in the number of messages. The progress of telegraphy in the Island has been of a very rapid nature. Before the Post Office purchased the rights of the Isle of Man Company, in August, 1870, the telegraph business had been conducted by one clerk and one boy messenger, and messages were sent to England by means of one double-current Morse writer, at the rate of about twenty words per minute, through the one-wire cable then in use. During the present season, seventeen clerks have been employed at Douglas alone, the number of telegrams dealt with in the month of September having increased from 19,116 in 1871 to 68,197 in the present year. To provide for the increase of work thus indicated, the Post Office recently laid a new three-wire cable, affording facilities for additional circuit arrangements in England. The Douglas office is supplied with two duplex Wheatstone instruments, each of which is capable of transmitting 400 words per minute, working direct to Liverpool and Manchester.

The Telegraph to India.—The steamship *Dacia* sailed from Greenhithe on Tuesday afternoon with a portion of the new cable for the Persian Gulf section of the Government Indo-European Telegraph. The rest was to follow in the steamship *International* yesterday (Friday). The expedition is under the personal direction of Colonel Bateman-Champain, R.E., Director-in-Chief of the Indo-European Telegraph Department, assisted by Sir Henry Mance, electrician of the Persian Gulf section, and a competent technical staff. The new cable is intended to strengthen the weakest portion of the Indo-European system—viz., the section from Jashk, near the mouth of the Persian Gulf, to Bushire. From Kurrachee to Jashk there is a land line as well as a submarine one, and from Bushire to England there are two distinct lines, one (the Indo-European) through Persia, Russia, and Germany, and the other *viâ* Bussorah, Bagdad, and Constantinople. While there are thus alternative lines at all other parts of the Indo-European system, the Jashk-Bushire portion depends entirely on submarine cables, of which there are at present two—one laid in 1864 and the other in 1868. From age both have long been in a dangerous condition, and in need of constant repair. The question therefore arose whether this weak section should be strengthened by a new cable or by a land line from Jashk to one of the stations in Persia—Shiraz, for instance. The former course was decided upon last May, and the present expedition is the result. The new cable is 530 miles in length. Including the expense of laying, it will cost £80,000. Among those who assembled at Greenhithe to wish the expedition God speed were Mr. J. Danvers and Major Jopp, R.E., of the India Office, and Colonel Murdoch Smith, R.E., Director of Persian Telegraphs.

The American Telegraph Service.—Referring to the letters of Mr. R. A. Proctor and another correspondent which appeared in the *Times* a short time ago, complaining of delays in the trans-Atlantic cable service and that of the American landlines, the *Electrical World* says:—"We would suggest the employment of good operators at fair salaries as a cure for the evil."

Canary Islands Cables.—The *Dia* of a fortnight ago announced the impending departure for the Canary Islands of an agent of the Postal and Telegraph Department, with a view to the laying of a cable between the Canary Islands not already in communication with one another, and between Gran Canaria and the Spanish African possession of Rio de Oro.

The International Cable Company.—The *Financial News* says :—"Mr. Otto Rochs is hard at work on the International Cable Company, which is expected to be brought out after the 12th."

The Kauffer Open Circuit Battery.—In this battery the porous cup is suspended from a tightly-fitting lid, thus gaining the exposure of the bottom surface, while the lid prevents evaporation, and all the connections may be removed with ease. The material for the cell is supplied in the form of a paste, an anhydrous solvent, to which water only need be added. It is claimed to be cheaper, more effective, and to last longer than sal ammoniac, and not to clog up the cup. Measurements made by an electrician in Boston show that the cell possesses an electromotive force of 1·57 volts and a resistance of 1·9 ohms.

The Brush Arc Lamp.—The Anglo-American Brush Electric Light Corporation informs us that the "Brush" lamp is the only one which can be relied on to work continuously without getting out of order, requiring only slight attention for years together even when working under the most trying conditions. The object of the corporation has been therefore always to avoid any kind of addition to the working parts, its hardiness and endurance far outweighing, in the opinion of practical men, any slight inconvenience from occasional flickering. Recent experiments in another direction have, however, shown that without any such addition to the working parts, but simply by a modification in the winding, the slight unsteadiness referred to may be effectually removed, and that this, like the previous improvements, can be introduced into all the lamps hitherto supplied by the corporation, and at a trifling cost. The "Brush" Corporation undertakes this alteration, but should users prefer to have it done by competent men in their own employ, the corporation will be prepared to supply them with the three bobbins required, wound with the new winding. In any case the corporation advises that two or three lamps should be sent to the works for alteration, to prove to owners the efficiency of the improvement and to serve as samples.

The Distribution of Light.—Last week we were necessarily compelled to hold over the report of the Franklin Institute on the Efficiency and Duration of Incandescent Lamps. With its continuation in our current issue, however, may be found diagrams illustrative of the distribution of light from the various types of lamps. It will be noticed how the luminosity of the Weston filament differs with the various planes through which it was examined.

The Standard of Light.—In connection with the correspondence which has been proceeding in the columns of the *Times* upon this subject, Prof. Silvanus P. Thompson has written as follows :—"No allusion has, I think, been made either in the letters of 'A. V. H.' or of your other correspondents to a point of some importance in the estimation of light by means of the so-called standard candle. The light from a standard candle will vary 4, 5, 6, or even more per cent. from its proper value according to the length and curvature of the wick, the unsnuffed candle giving less light than the snuffed one. I have always to point this out to students who are beginning to use the photometer as a continual and inherent cause of erroneous determinations. Anyone who has a photometer and a few of Mr. Sugg's standard sperm candles (there are no better ones to my knowledge) can easily verify the fact. Any fraudulent gas tester, if such exists, can readily make a 15-candle gas appear by the tests to be giving 16-candle light; he has only to leave his standard candles unsnuffed for a minute or two. The standard being thus debased 5 or 6 per cent., the gas appears by comparison 5 or 6 per cent. better than it really is."

Remarkable Experiment in Photography. — Mr. Joseph R. Holmes, of 12, Waterloo Street, Glasgow, is at present in the Western Infirmary suffering (says the *North British Mail*) from a severe attack of erysipelas in his face, contracted, it is thought, when, in the interests of science, taking photographs of the Forth Bridge in one of the caissons at the bottom of the sea. The electric light was the illuminant used. There was a very heavy air pressure. Photography has never before been practised under such difficulties.

Ships' Signals.—The *Liverpool Journal of Commerce* has an article upon "Signals to engineers from the deck," in which it points out the confusion and danger likely to arise in consequence of the want of uniformity in the methods employed for communicating between the officer of the watch and the engineer. Bells, speaking tubes, call-boys, electrical apparatus, &c., are variously used, and there are even differences in the code for the same means on different ships. Our contemporary recommends that a recognised code of engine-room signals be prepared and put into practice.

Gas Engines.—In an article upon "Gas Engines at the Inventories," the *Electrical Engineer* complains of the neglect of the South Kensington authorities to submit the engines of the various makers to unbiassed experiment, remarking that they have for the purpose all the unrivalled advantages of State aid and the use of Government official machinery. "Every requirement," the article continues, "is, or was, here at command ; but useful work of this kind is shirked as not amongst that which appeals to popular favour. It is also not impossible that one of the many wires which effectually pull behind the scenes, a wire attached to a name and not to a merit, has been successful in showing that, however much it might be to the public advantage to have results of complete investigation into the merits of several gas engine designs, the result would, perhaps, not be to the advantage of more than one maker, and that might possibly not be the one who is most in South Kensington favour. . . . . Is there no society, institute, or body existing that can come forward and offer a high award for the best gas engines, just as the Royal Agricultural Society used to award prizes for the best steam engines, until a high efficiency was attained?" Further on, the writer remarks:—"At present we are without any really satisfactory information on many important questions concerning the use of explosive mixtures in gas engines, and the design of gas engines as affected by the behaviour of explosive mixtures, homogeneous or otherwise, and a valuable field for experimental research on a practical scale here lies open for the exploration and advantage of any competent man or men who will undertake it."

Copper *v.* Iron Telegraph Wires.—We understand that Prof. Hughes is investigating, by aid of the induction balance, the greater susceptibility of copper wires to changes in the current traversing them as compared with iron : a fact mentioned by Mr. Preece at the British Association meeting, and elicited by the recent trials of speed made by the Post Office on the new copper line from London to Newcastle.

"The Electric Light Brought Home to Us."—This is the title of a penny pamphlet issued by the Anglo-American Brush Corporation. It appears to us chiefly intended to impress the uninitiated British populace with the idea that Mr. C. F. Brush invented compound winding, as the public is warned against purchasing compound wound dynamo machines other than those manufactured by the corporation or its licensees.

An Electro-Mechanical Clock.—An application of electrical power to the automatic winding of clocks has been invented by Mr. Chester H. Pond, an American gentleman, and is exhibited at 29, Leadenhall Buildings. We shall endeavour to describe the system in our next issue.

Honours to an Electrician.—Mr. J. A. Betts, A.M. Inst. C.E. and M.S. Tel. Eng. and Elec., has been created by His Imperial Majesty the Emperor of China, a Civil Mandarin of the 4th rank, with the decoration of the peacock's feather 2nd degree, and the order of the "Pau Shing" or Precious Star of China. This is quite an exceptional honour, as *civil* rank is scarcely ever bestowed upon any but the Chinese literati, being considered far higher than military rank. Mr. Betts has been engaged during the whole of the Franco-Chinese war in the torpedo defence of South China, and it is in recognition of the successful defence of Canton, carried out under Mr. Betts's sole control, whereby the French fleet were kept at a distance for some ten months, that these honours have been awarded him. The Chinese gentry and merchants of the City of Canton have also presented Mr. Betts with a silk embroidered banner and a massive silver vase, with an inscription stating that it is presented as a sign of their gratitude for preserving the city from probable bombardment and plunder. We understand Mr. Betts has suffered severely from malarial fever during the war, and is likely to return to England shortly to recruit his health.

The New York Underground Wire Commission.—The Commissioners have given inventors and others until October 15th to present and explain their designs. We see it stated that before the Commission recently, "W. C. Barney, of Washington, claimed that he had invented a wire which was free from the influence of induction." The report ends with that announcement.

The Brooklyn Underground Wire Commission.—This Commission has handed in its first report, which, says the *Electrical World*, contains some conclusions that have been admitted long ago. The report does not offer anything final; is, in fact, merely preliminary.

The Stearns Duplex System.—The Western Union Telegraph Company is proceeding in the United States Circuit Court against the Baltimore and Ohio Telegraph Company to restrain the latter from further use of the duplex system of telegraphy, which is claimed to be the exclusive property of the Western Union Company under the patents of Joseph B. Stearns. The answer is, that there is no substantial foundation for the claim set up, the re-issue of the Stearns patent in 1882 being invalid in that it was not a re-issue of the original patent, but the issue of three new and separate patents, including claims for inventions made known within the ten years since the original patent was granted. In addition to this legal point, the Baltimore and Ohio Companies' expert testimony asserts that the use of the condenser, as limited to one station, was anticipated by Cromwell Varley, of England, and the latter's combination is what is now used by the Baltimore and Ohio Company.

Her Majesty's Theatre.—We see it stated that Her Majesty's Theatre, the installation of the electric light at which we recently described, will pass next year into the hands of the postal authorities.

A Peculiar Leak.—The *Electrical Review* of New York describes a peculiar leak which occurred recently in an electric light circuit. The circuit, including the dynamo, was in excellent condition, its insulation measuring higher than required by law. The next day the insulation had dropped to an almost dead ground. The floor had in the meantime been painted with mineral paint, and the artist had decorated the lower part of the frame. The armature was in contact with the frame, and the machine was consequently grounded.

Appointment.—Mr. W. H. Fleming, of Baliol Chambers, Stanley Street, Liverpool, has been appointed sole agent for Liverpool and district (inclusive of Manchester), for Scott's hardened India rubber varnish.

Fire on the Blackpool Tramway.—Flames were seen bursting one day last week from the centre channel of the electrical tramway at Blackpool. Endeavours were at once made to put them out, but it was not until the hose-cart had been brought from the town's yard and a copious supply of water poured into the channel that the flames were extinguished. A local journal says of the outbreak: "It was conjectured, in explanation of this remarkable occurrence, that there had been a leakage from a gas main which passed under the line, and that the electric current sent along the conductors had fired the gas collected in the channel, and thus caused the flames. This, however, was not the true explanation of the peculiar conflagration; for we believe we are right in stating that it was entirely due to some disarrangement in the electrical appliances."

The Colonial Exhibition of 1886.—It is generally believed in regard to this forthcoming exhibition, that the completeness of arrangement connected therewith and the number and variety of its attractions, will surpass any of its predecessors in interest and magnificence. All available space, we hear, has been taken up long since.

A Curious Electro-Chemical Phenomenon.—Mr. B. H. Thwaite, writing to *Engineering*, states that he uses for the microscopic and analytical work in his laboratory an electric incandescent (hair filament) lamp of 5·2 volts; the necessary electric energy is obtained from a four-cell battery. The porous cell contains a coiled piece of zinc, which presents a considerable surface to the very dilute sulphuric acid, a few drops of SO_4 added to the water in the porous pot is all that is required. The vessel is to be filled with one part SO_4 to ten parts saturated solution of bichromate of potash (K_2 Cr O_4 Cr O_3), and with broken pieces of electric arc carbons. This battery is not expensive, and is very effective and fairly constant. Care must be taken not to acidulate the water in the porous pot too much, otherwise the intense electric action will destroy the porous pots in a very short time. On examining one of the cells the other day it was noticed that at each of the terminals or ends of the broken pieces of carbon there was one or more beautifully formed six-sided prismoidal crystals, almost black in colour, but when held between a ray of light giving a beautiful carmine colour inclined to purple; part of the crystals when exposed to the air became covered with a light purplish film. It would be interesting, says Mr. Thwaite, to know if this phenomenon has been noticed by others. The only explanation that he can give is this, the porous cell was slightly cracked, and the acidulated water may have been mixed with the bichromate solution, forming crystals having this formula, KC_3 $2SO_4$ + 12 Aq; but why they should be attached to the ends of the pencil pieces of carbon is not so clear.

[The formation of chrome alum crystals (the crystals in question) on the carbons of bichromate batteries when the solution reaches a certain density is quite common.—EDS. ELEC. REV.]

Underground Telegraphs in France.—The *Petit Marseillais* says that the underground telegraph line from Paris to Lyons and Marseilles is completed, and the wires will be used as soon as the instruments destined for them are placed in the offices at Paris, Lyons, and Marseilles. This underground line, added to those overhead, will not only enable messages to be accelerated, but will enable communications to be kept up no matter what the state of the weather may be. Underground lines will also be laid between Marseilles, Toulon, and Nice. Marseilles and Havre are already connected by a direct wire, and this not only secures rapid communications between the two ports, but places Marseilles in direct connection with the United States, as the Marseilles-Havre wire is to all intents and purposes the prolongation of the Franco-American cable which abuts at Havre.

Blowing Up Hell Gate.—The rock at one of the entrances to New York Harbour, forming what is known as Hell Gate, was to have been removed in the early part of this week, but the operations were postponed until to-day (Saturday), defects having been discovered in the insulation of the wires connecting the rock with the shore, which are to be used for exploding the dynamite charges.

South Australian Telegraphs.—Mr. Charles Todd, Postmaster-General of South Australia, writes that with a view to a reduced through rate of 8s. 8d. on private messages, South Australia will reduce her rate for transmission over the land line between Port Darwin and Adelaide from 1s. 3d. to 1s. 1d. per word, and to effect a reduction on Press messages to 2s. 8d. per word she will reduce her rate from 1s. 3d. to 4d. per word. South Australia has expended £500,000 in the first erection and subsequent re-poling with iron poles of the line across Australia, and she sustains an annual loss of about £25,000, including interest on outlay.

Disappointed Telegraphists.—The American telegraph operators who recently left the States under an engagement with the Siamese Government, now complain that they have been deceived, their pay, $120 per month, being $75 less than other telegraphists receive, the latter looking upon the new arrivals as cheap American labour. They say it will cost $200 per month to live decently; and conclude their communication with the remark, "When we have money enough we will return."

Erratum.—In the letter of "G. R." published last week, *for* "Lante" *read* "Laute."

OFFICIAL RETURNS OF ELECTRICAL COMPANIES

Chelsea Electricity Supply Company, Limited.—At an extraordinary general meeting of this company, held on the 23rd July, it was resolved, "That article 82 of the articles of association of the company be altered by striking out the words 'member or members of their body' in line 2 thereof and inserting in their place the words 'shareholders of the company.'" This resolution was confirmed on the 7th August, and duly registered on the 5th inst.

West African Telegraph Company, Limited.—The registered office of this company is at 106, Cannon Street, E.C.

CITY NOTES.

Anglo-American Telegraph Company, Limited.—At a meeting of the board of directors it was resolved, after placing the sum of £25,000 to the renewal fund, to declare an interim dividend for the quarter ending 30th September, of 5s. per cent. on the ordinary stock and 10s. per cent. on the preferred stock, less income-tax, payable on the 31st October to the stockholders registered on the books of the company on the 30th September, 1885.

Eastern Telegraph Company, Limited.—This company announces the payment, on the 15th inst., of a dividend of 3s. per share on the preference shares, less income-tax, for the quarter ending September 30th, and that an interim dividend of 2s. 6d. per share in respect of profits for the quarter ended June 30th, on the ordinary shares, free of income-tax, will be paid on the same day.

Direct United States Cable Company, Limited.—The directors of this company have decided to pay, on the 24th inst., an interim dividend of 3s. per share, being at the rate of 3s. per cent. per annum for the quarter ended September 30th.

Submarine Cables Trust, Limited.—Notice is given that the coupons due on the 15th inst. will be paid on and after that date by Messrs. Glyn & Co. between 10 and 2.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of September was 2,582, estimated to produce £2,100, against 2,643 messages, producing £2,163 in the corresponding month of last year. The receipts for the month of June, estimated at £3,000, realised £3,032.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 30th September, are £1,849, as compared with £2,069 in the corresponding period of 1884. The June receipts, estimated at £5,860, realised £5,945.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 2nd were £2,451, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Great Northern Telegraph Company. The receipts for September, 1885, £23,200; from 1st January to 30th September, 1885, £217,240; for the corresponding months of 1884, £208,680; and of 1883, £191,880.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of September were £1,770, against £1,663 in the corresponding period of last year.

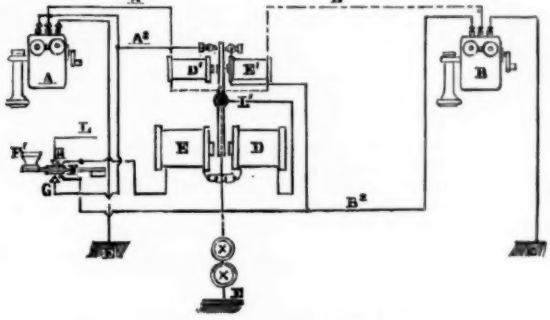
The Eastern Extension, Australasia and China Telegraph Company, Limited. The receipts for September, 1885, amounted to £41,845, and to £41,500 for September, 1884.

The Eastern Telegraph Company, Limited. The receipts for September amounted to £47,849, and to £50,913 in the corresponding period of 1884.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending September 30th were £3,080.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

9855. "Improvements in telephone switches and circuits." P. JENSEN. (Communicated from abroad by Messieurs. Stockholms, Bell Telefon Aktiebolag, Stockholm.) Dated July 7. 6d. This invention is intended for fitting two telephones, A and B, in different neighbouring houses, or in different parts of the same house, at one end of a single line, the other end of which is in direct connection with the central exchange station in such a way by means of a switch actuated from the central station, that the holder of either of the two telephones, A or B, shall be able to communicate without any hindrance with any subscriber, without the other holder, A or B, being troubled nor able to interrupt the communication, and so that the two holders, A and B, shall also be able to use the mutual line for talking to each other. When A, for instance, has ceased to talk, B may use the line in the same way. The exchange is made automatically, and so to say without the subscribers knowing it. The fig. is a diagram showing the two telephones for A and B with the switch appliance, and with the circuits for connecting with the central station, main line, and local batteries. L is the line leading to the central exchange, and terminating in the contact point, H, against which the spring, F, presses, thus through the contact, *f*, and bobbins, E and D, and the line, L^1, connecting the latter with the switch appliance, and its lever armature, C, which at its upper end has two small springs making contact with the screw *a* or the screw *b*. The latter through wires A^2 and B^2 connect with instruments A and B, and thence to earth in the usual manner. A and B are connected with the switch through A^1 and B^1, which circuits traverse the bobbins, D^1 and E^1, and are finally united into a single line, which is connected with one pole of a local battery, the other pole of which is



connected to earth. The central exchange, in order to connec any other subscriber with either of the two, A or B, has only to send forth during a moment a positive or negative current, depending upon which of the two, A or B, is wanted, whereby the armature, C, is drawn to one side or the other by the electro-magnets, D or E, and the circuit switched to one side or the other, and connection is made as required to A or B by reason of the polarised armature contact, C, being thereby automatically shifted over against the contact, *a* or *b*, thus connecting the line, L, through either A^2 or B^2 with the instruments, A or B. The lines, A^1 and B^1, are connected with the bells at A and B. A small spring near the telephone hook, which forms the terminal A^1 and B^1, makes contact with the hook and to earth every time the receiver is lifted off, thus closing the circuit of the local battery through the bobbin, D^1 or E^1, to the earth. The armature, C, therefore makes contact with *a* or *b*, according to whether A or B takes off the receiver, and consequently A or B can connect himself antomatically into the central office line. The contact, F, is provided

with a button, F¹, which may be arranged on the wall or back board of the instrument, or be put inside the call bell with only the end protruding. If A desires to speak to B he depresses the button or key, F¹, thus making contact with a, rings up B, and holds the button in the depressed position during the whole conversation. Whilst A and B are thus speaking with each other, the central station line remains open, thus preventing any interference and showing the latter that A and B are talking together. If B in the first instance desired to speak with A, he calls up the central station in the usual manner, asks for A, replaces his receiver on the hook, and awaits the signal from A. The central exchange calls up A and tells him to ring up B, and A then depresses the button, F¹, and can thus talk with B.

10487. "Improvements in the construction of holders or sockets for incandescence electric lamps." R. P. SELLON and G. C. SILLAR. Dated July 23. 6d. Fig. 1 shows a side elevation of the lamp fixed to the holder. Fig. 2 is the same, but the holder and lamp have been turned through an angle of 90°, and the holder is shown partly in section. The holder consists essentially of a cap or base, *a*, made of any suitable material, by means of which the holder is fastened to the fitting. To this cap, *a*, the inventors fasten, by means of hinges, *b*, one or more tongues, *c*, of metal or other suitable material, two only shown in the drawings, forming the sides of the holder, in which is stamped a groove, *d*, of suitable shape, to take an annular spiral spring or collar, *e*, the tendency of which is to bring the tongues, *c*, towards one another. In the cap, *a*, is placed a disc or piece of suitable insulating material, *f*, through which are drilled two holes, *g*, *g*. In these holes are

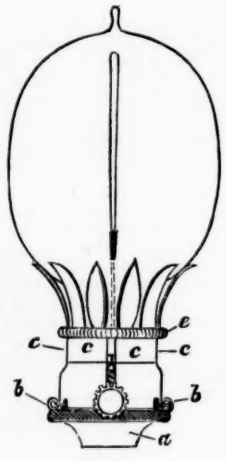


FIG. 1.

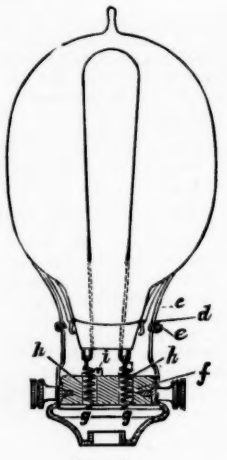


FIG. 2.

placed two small spiral springs of some suitable conductor of electricity, *b*, *b*, which are electrically connected to the screws, *c*, *c*, fixed to the disc, *f*, and have small hooks made in their free ends. Through the disc, *f*, are also drilled two other holes, the object of which is to hold and keep apart from one another the wires from the source of electricity. When it is desired to place the lamp in the holder, the tongues, *c*, are opened out, the spring, *e*, thereby, flying back to the base, *a*. The two eyes formed in the neck of the lamp are then threaded into the hooked shaped ends of the springs, *h*, *h*, the tendency of which is to keep the neck of the lamp close against the disc, *f*. When the tongues, *c*, are brought together again, the lamp is forced out from the disc, *f*, the annular spring or collar flying back and bedding in the groove, *d*, and thereby pulling the tongues, *c*, close together. In this way an efficient electrical connection is made and maintained by the lateral grip of the spring, *e*, on the tongues, *c*, together with the outward push of the lamp from the disc, *f*.

CORRESPONDENCE.

Compound-Wound Dynamos.

S. ALFRED VARLEY'S PATENT, No. 4905, 1876.

Attention having being called to the above invention, which forms the subject of articles and correspondence in your last two issues, perhaps I ought not to be quite silent on the subject. All I feel called upon to say, however, at the present time is to express the hope that Mr. Sellon will give the world evidence of the soundness of the faith he professes, by carrying into the Law Courts the claims now being asserted by the Anglo-American Brush Corporation.

S. A. Varley.

Although you have, by your editorial, answered the letter of Mr. John S. Sellon which appeared in your last issue, I would ask your permission to state that my opinion was not formed only upon the extract from the specification I quoted, but is founded on other facts in my possession.

In answer to Mr. Jas. Swinburne, I would draw attention to the fact that my opinion was given simply upon the validity of the Brush Company's claim, and not as to who was the originator of double-winding as developed by experience into our modern compound-wound or constant E.M.F. machines—and it will be noticed, on reference to the article, that I was expressly guarded in my language as to this point, for I used the words, "*the species* of compound-winding as claimed by Brush had been anticipated."

J. S. Beeman,
Engineer and Electrician.

44, St. Oswald's Road,
West Brompton, S.W.

Possible Dangers from Secondary Generators.

A danger which seems to me to be as likely to threaten as that suggested by Dr. Hopkinson, is from the primary current finding its way to the secondary circuit, the primary being anywhere earthed; then certain death to the person making another earth through his body on the secondary circuit.

The combination of possibilities necessary to produce such a result are by no means impossible. The separation between the primary and the secondary is necessarily very little, and if the insulation be broken down by faulty workmanship, progressive decay of the insulator, or accidental contact from proximity of terminals on transformer, we have one element; the second is supplied by a telephone wire in contact with charging line or an accidental earth in machine room; and the third by a person, say, adjusting the spiral contact at a lamp holder and at the same time touching the gas fitting which carries the holder, or by touching a one-wire bracket and his foot on the steam pipe or radiator beneath it; then these three possibilities occurring together, constitute the danger I desire to point out.

If the secondary be earthed, as suggested by Dr. Fleming, the danger disappears; but the two first possibilities would result in wholly or partially extinguishing the lights fed from the faulty transformer. If Dr. Fleming's suggestion be adopted, why not at once use gas pipes and fittings as return? This practice has been very generally condemned; but if, to guard against the consequences of accidental earthing of the feeding line, which would short circuit the secondary circuit, safety fuzes were used with a judicious liberality, would it be a serious objection?

Zemba.

Thompson's Electric Light Switches.

Mr. N. G. Thompson's switch, figs. 1 and 2, page 269, seems from sketch to be identical with one made and used in the United States two years ago; there is nothing unusual in the same thing being invented or designed over and over again, but Mr. Thompson might like to know that he has been anticipated before he spends money on patents, at least on United States ones. This switch is not, I think, patented in the United States, but the company there who has used it, could and would most certainly still do so in spite of his patent.

Zemba.

Magnet Steel.

While searching for records of the best steel from which to make permanent magnets, I fell across the following passage in a paper by Mr. Adam Scott, read before the Society of Telegraph Engineers on April 23rd, 1879:—"The magnet is made out of a peculiar kind of French steel, very porous in its nature, and has

been magnetised in a special manner, which is at present the only secret of the manufacturer. The result of the combination is a permanent magnet of great power, capable of lifting at least ten times its own weight."

Can any of your numerous readers tell me the name and address of the manufacturer above-mentioned, or if not, the name of any other manufacturer whose steel they believe to answer the purpose best?

If through the medium of your excellent journal you would kindly submit these questions to them, you would greatly oblige,

Magnet.

October 1*st*, 1885.

Swan Lamps.

You would oblige me very much by inserting the following in your Correspondence columns.

I recently tried some of the new Swan lamps manufactured by the Edison-Swan Company and, in spite of the assurance of the company that these lamps only require 2·5 watts per candle, I found that 0·7 ampère was necessary for each 100 volt 16 C.P. lamp, which is 4·5 watts per candle.

Would the company be so good as to explain this singular fact to

"Please?"

Ghent, *October* 5*th*, 1885.

[Probably our correspondent's ampèremeter did not register correctly.—EDS. ELEC. REV.]

The Future Source of Electric Energy.

The interesting paper read by Prof. W. G. Adams at the British Association, on the Electric Light and Atmospheric Absorption, which you publish in your issue of to-day, suggests other thoughts besides those which fall within its immediate scope. And if I allude to the question of the energy of radiation, it is one with which your readers must be already familiar.

We heard a rumour, I think a few months ago, that Mr. Edison was purposing to obtain electricity "direct from coal," without the intervention of steam and the dynamo machine. And were he to succeed in that enterprise by means of the same indomitable application which has enabled him to succeed in so many others, would that be the bourne of progress or is there in the nature of things a possibility of obtaining electricity still more "direct," viz., without even the intervention of coal? An answer is suggested by the anecdote about George Stephenson and his friend the geologist with whom he was walking when the locomotive passed by. Stephenson told his companion that the cause of the mysterious movement was not, as he imagined, coal but the sun, and proceeded to remind him of the origin of coalfields. Some day I am afraid the sun will turn a good deal of soft iron upon the market in the form of superfluous dynamo machines.

Whilst looking over some back numbers of your contemporary, *La Lumière Electrique*, I came upon a contribution on the mechanical equivalent of light, in which to my surprise the writer, Mr. Frank Geraldy, concluded that this equivalent must be very small. What astonishes me so much is, that even in the more recent researches in connection with the energy of radiation, I do not readily hear of an appeal to any judge but the thermopile. But we need only turn to the trees to see that many rays possess great energy of a kind that cannot be directly commuted into heat. Let the thermopile and the radiometer alone; cut down a tree and oxidise the carbon it contains in the flue-pipes of a steam-engine. The energy so obtained has been stored up from the absorbed actinism of solar radiation, whereby the carbonic acid of the atmosphere is disintegrated and the carbon stored up for re-oxidation, as it were in an accumulator. Does not the very colour of the spring leaf whisper a secret to the thoughtful mind? Does it not show us that the rays which are predominantly being utilised are of a kind rich in actinism? We must not conclude that a power is small merely because we have not learnt how to apply it; high-pressure steam might be let in on both sides of a piston at once without achieving any great result for us. But when these things have been duly meditated upon, we shall cease to say that the mechanical equivalent of light is small, and shall amuse ourselves by driving a current *with an arc-lamp*.

E. Aldred Williams.

37, Burlington Road, W.
October 3*rd*, 1885.

High Speed Engines.

Our attention has been drawn to a paragraph in your issue of the 19th of September, copied from a contemporary, with respect to the high speed engines at the Inventions. We have nothing to say for or against the general remarks except as regards the sweeping assertion that all the high speed engines shown there are bad.

May we be allowed to state that we have been running two of our Thomson-Houston dynamos off a high speed Armington and Sims engine by Messrs. Greenwood and Batley of Leeds since the opening of the exhibition with the utmost satisfaction, and we must say that we are highly delighted with the performance of the engine, its wonderful governing qualities, its handiness and its general reliability, and we may say that we have had far less trouble as regards our lights with this engine than with the other machine on the main Davey-Paxman engine as we have had to cut out our lights on this engine on three or four occasions owing to circumstances beyond our control. We may also mention that in the United States there are more than 90 of these Armington and Sims high speed engines running double that number of Thomson-Houston dynamos, and many of them have been in use for several years, having given complete satisfaction to all parties concerned.

Laing, Wharton, and Down.

London, E.C., *October* 5*th*, 1885.

The Society of Telegraph Engineers and Electricians.

At the present time everything electrical is attracting an unparalleled amount of healthy attention. Scientific and practical men are devoting themselves in increasing numbers to the study and application of electricity. Steady progress is being made in all directions. Time, "the great healer," is doing his best to close the wounds inflicted by the company-mongers, and public interest and faith are being re-awakened. Under these circumstances it might reasonably be expected that the Society of Telegraph Engineers would be making itself useful in advancing the interests, scientific and practical, of electricians; that it would be identifying itself strongly with current thought, and growing and strengthening in a manner commensurate with the developement of everything connected with the science it is supposed to represent. As a matter of fact it is to be doubted whether the Society can be considered to be representative in any sufficient sense. The best papers of the best men are found to gravitate to other societies.

Let the Society take a lesson from the Institution of Civil Engineers, which has recently issued its annual list of subjects on which communications are invited. In this list, which embraces almost every subject in the whole range of engineering on which information is specially wanted, are to be found some of the more important and interesting applications of electricity, a well-made choice being made of those which are ripe for discussion. And not only does the Institution invite communications of this sort—it does everything possible to promote discussion. Although not connected with the Institution I have received tickets for meetings at which electrical papers were to be read, proofs of those papers have been sent to me, and I have been

asked to give the names of men capable of contributing useful information on the subjects. And this certainly for no other reason than that I happen to be an electrician. On the other hand, although an associate of the Society of Telegraphic Engineers, I never receive a proof of a paper and have never seen anything to indicate that trouble was taken by the Society to promote or ensure proper discussion of the papers read at its meetings. There is every reason to believe that a liberal distribution of advance copies has the effect of greatly enlarging the scope of a discussion. At the meetings of the Society it may also be objected that an undue share of the work is permitted to fall upon a few able men who are gifted with an ability to speak at any length on any electrical subject whatever. While feeling grateful to them for their efforts, I venture to suggest that some attempt should be made to obtain the assistance of a greater proportion of the rank and file, or of outsiders. In his inaugural address the President, indeed, officially invited the younger members to come forward, but it should be borne in mind that as a rule those who are not accustomed to addressing audiences will not get up to criticise a paper or to contribute information on the subject unless they have had time to examine the matter beforehand.

I may also draw attention to the unbusiness-like want of punctuality in commencing the meetings of the Society. This has so bad an effect that at the proper hour for commencing there is frequently only a handful of members present, the great majority timing their appearance to suit the custom of the council and officers.

A.S.T.E., Member of Society of Arts.

October 6th, 1885.

Secondary Generators or Transformers.

We should be very obliged to you for giving us some of your valuable space to refute the statements made by Messrs. Gaulard and Gibbs in your issue of September 19th, and which are apt to mislead the public in respect to the relative values of our system and theirs.

Firstly, Messrs. Gaulard and Gibbs try to prove that their secondary generator is superior to ours, in spite of Prof. Ferraris having demonstrated the contrary. But they overlook that our apparatus is designed for four horse-power, whilst theirs will barely yield two; this fact is not changed by connecting up two coils of one generator in parallel circuit, whereby only the primary and secondary tensions are reduced by one-half, and both currents doubled, without in any respect making the apparatus more efficient, as it was. Consequently Prof. Ferraris is right in stating the relative weights of copper for the same capacity of transformers to be as 14 kilos. with ours to 36 kilos. with Gaulard and Gibbs. This, and the relation of iron to copper (2 to 1 in our transformers and about 1 to 6 in those of Messrs. Gaulard and Gibbs) will prove that we have embodied other principles in our induction coils than those gentlemen. Another fundamental difference is this: in our transformers any one single winding has the same value, quite irrespectively of its position in the coil. Therefore it is evident that two coils composed of equal numbers of windings are equivalent; and we make use of this in coiling the wires in a convenient way, without regard to the position relatively to the iron core. Messrs. Gaulard and Gibbs, on the contrary, in order to have a good effect, must anxiously take care to secure perfect symmetry in the coils, and even then, by coupling the parts of one or the other in parallel circuit, the efficiency of the apparatus is materially impaired, as was demonstrated at Turin. This is caused by the windings on the middle of the iron core having an electromotive force 30—50 per cent. higher than those at the ends of it.

Messrs. Gaulard and Gibbs are undoubtedly to be credited with first having proved the practical applicability of secondary generators; but a good deal of the pains they took to construct such apparatus could have been spared, as in Maxwell's treatise, part 4, chapter 12, art. 679, the best proportions for cylindrical transformers, as used by these gentlemen, are clearly set forth. In the articles about solenoids, there are also laid down some of the principles involved in the construction of our induction coils, and which explains also their superior qualities.

Messrs. Gaulard and Gibbs's reference to Fuller's apparatus as being anterior to ours only proves that they are not aware of the fundamental difference between Fuller's transformers and ours, and which is the cause of the superiority of our induction coils; *i.e.*, Fuller coils the wires in such a manner as to have consequent magnetic poles in the iron core, the lines of magnetic force having to pass from the one to the other through air, which is also the case with Messrs. Gaulard and Gibbs's secondary generator; we, on the contrary, coil our transformers in such a way as to have no free magnetic poles at all, the lines of force always circulating in iron of low magnetic resistance.

As is well known, in Messrs. Gaulard and Gibbs's system, though the different points of consumption are to a certain degree independent from one another, this is not in the least the case with the individual lamps of any one local centre, for the secondary tension is increasing in proportion as the number of active lamps diminishes, and this at a quite dangerous rate; only by the use of a self-acting resistance or similar apparatus, all of which are not very reliable, can the tension at the lamps be maintained constant. Now, in favourable contrast to this, our system is entirely self-regulating, without the use of any mechanical apparatus. The tension used by any consumer is held absolutely constant by connection in parallel circuit of the transformers, by the exceedingly low internal resistance of these, and by compounding the alternate current dynamo. Thereby any mechanical regulating appliances are avoided, and the conditions for all lamps are the same as in an ordinary parallel arc system with compound dynamo. Of course, each consumer may have lamps of the type best suiting his requirements; the secondary tension being only fixed by the transforming co-efficient of his individual secondary generator. Any arc lamps designed for constant potential with alternate currents may be used, and we have here daily lit Zipernowsky arc lamps connected in parallel circuit with Swan lamps fed by transformers.

Messrs. Gaulard and Gibbs give an extract of the report of the International Jury of Turin on their invention, and charge us with having obtained satisfactory results only by observing the conditions explained in this report. Though the jury may have stated the transformers of Messrs. Gaulard and Gibbs to be the best known at that time, this could in no way preclude our afterwards coming forward with induction coils of superior capabilities and different construction, and we are glad to observe that even Messrs. Gaulard and Gibbs acknowledge that our transformers comply with all requirements for such apparatus as were formulated by a jury formed of the most eminent scientific men.

Messrs. Gaulard and Gibbs know as well as we that the only common feature of their system and ours consists in the use of alternate currents and the inductional properties of these. But therewith the similarity is at an end—as Mr. E. Hospitalier has already observed in No. 123 of *L'Electricien*—our dynamo, its regulation, the form and construction of the transformer, the mode of connecting up the parts of the system, are all quite different to theirs, and designed with the distinct view to insure absolute independency of the individual lamps.

After all this it is rather singular to hear these gentlemen speak of infringement of their patents, and the preceding explanations should prove them the weakness of their charge brought against us of having built up our system only on the knowledge of the facts relating to their apparatus shown at Turin.

Charles Zipernowsky.
Max Deri.
Otto T. Blathy.